SAN FRANCISCO BAY REGION

SOCIETY of ENGINEERS

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1926

THE METROPOLITAN AREA

Comprising

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Foreword

THEODORE ROOSEVELT said: "Every man owes some of his time to the upbuilding of the profession to which he belongs." The marked effect of engineering society organizations so far as the profession is concerned has been to stimulate the practical intellect to its utmost extent of activity. The men who contribute to the enterprise of their respective vocational institutions, by reason of their opinions, efforts and purposes do so in the interest of the profession by providing fields, opening channels and creating achievements for the benefit of new energy and inspirations.

The technical society in its importancy, founded and dedicated to the concern of scientific research, the consideration and systematic study of potential problems, the developing and recording of those findings prompted by learning, talent and genius have settled on the solid foundation of a mutual understanding while their materials so requisite to engineering have become accepted practice.

Creative energies essential to progress have caused every river, lake, forest, plain and mountain, a continent replete in startling events and engineering achievements to be reclaimed to agriculture, transportation and commerce. Just as these movements represented by structures built in fabric to endure, so men's thoughts, their ambitions and fundamental objectives become the indications of a future order.

This social body has been formed in the conception and belief that the best and most important lessons compatible to honor the profession and promote respect for professional propriety and principle can best be developed and advanced by joint influence. To feature entertainment with instruction that will adapt itself to attract attenion and favor. To achieve objects that will possess the greatest assurance of value in the interest of the high standing and character of engineers and their profession.

The Society of Engineers will exert effort to earn the confidence, co-operation, friendship and good will of all institutions interested in or devoted to the profession.

—GEORGE E. TONNEY.

Contents

Beauty of geometric precision, stately in command, and substantial in strength of character.

Federal Harbor Improvements at San Francisco

By Major John W. N. Schulz
Corps of Engineers, U. S. Army, District Engineer in Charge of First San Francisco District

San Francisco possesses one of the finest natural harbors in the world. The Bay of San Francisco is 40 miles in length, from 3 to 10 miles wide, and has 36 square miles of anchorage area with depths varying from 40 to 90 feet. The Golden Gate varies in width from about seven-eighths to two and a third miles, and is of great depth, generally more than 100 feet, and with a maximum reaching 382 feet.

The San Francisco Outer Bar.

Five miles outside of the entrance strait, there is a submerged barrier, or bar, of the usual crescent shape, known as the San Francisco Outer Bar. The outer bar is about 13 miles long and extends along a rough semicircle from the general vicinity of Point Bonita, on the north, to the ocean beach of San Francisco at a point about three miles south of Point Lobos, on the south. The general depths of water over the bar vary from about 23 feet near the northern end of the crescent to about 34 feet at the southern end. The width of the crest of the bar, at a depth of 36 feet, varies from about one-half to one and three-fourths miles.

There are three natural channels across the outer bar, by which access from the ocean is gained to the Golden Gate and thus to San Francisco Bay. Near the center of the bar is located the so-called main ship channel, which, before improvement, had a natural controlling depth of about 34 feet. The improvement of this channel by the Federal Government to more than 40-foot depth has just been completed. The other two entrance channels consist of the Bonita Channel, at the north end of the bar, and the South Channel, at the south end. The South Channel follows a rather tortuous course close to and parallel to the shore and is seldom used by large vessels. Bonita Channel lies between the northern portion of the bar, known as the Four Fathom Bank, or "Potato Patch," and the main shore, and is approximately two and a quarter miles long. The maximum depth of water in Bonita Channel is 69 feet, with a controlling depth of 54 feet at mean lower low water.

Depths of Harbors in the United States.

To appreciate fully the advantages given by nature to San Francisco Bay and Harbor, the foregoing depths may well be compared briefly with the conditions which obtained originally at some of the other great harbors of the United States. A striking example is New York Harbor, where the natural entrance depth across the bar, and that by an indirect channel, was only 23½ feet. By the direct, or Ambrose, channel, the original depth was only 16 feet. The original depths at Boston Harbor were from 18 to 23 feet; at Philadelphia, 17 feet; at Baltimore, from 15 to 20 feet; at Portland, Oregon, 10 feet; and at New Orleans, 9 feet. The present project depths for these harbors vary from 30 to 40 feet, with which may be contrasted the Bonita entrance into San Francisco Bay, with its natural controlling depth of 54 feet.

The channels dredged by the United States at its various Atlantic, Gulf, Pacific and Great Lake ports, and the continued maintenance of such channels, are clearly essential to our foreign, coastwise and internal commerce and to the well-being of our great ports. If, for any reason, maintenance of these channels should be neglected and they be allowed to deteriorate to their natural conditions, the effect on the commerce of the United States and on the prosperity of the ports affected and the country as a whole would be disastrous.

San Francisco Harbor has long enjoyed a position of premier importance along the Pacific Coast, because of the natural excellence of its harbor and entrance, the strategic location of San Francisco on the Pacific Coast and at the outlet of the great California interior river valleys, and the efficient and well-administered system of terminal facilities which serve the port. The terminal facilities are under the control of the Board of State Harbor Commissioners.

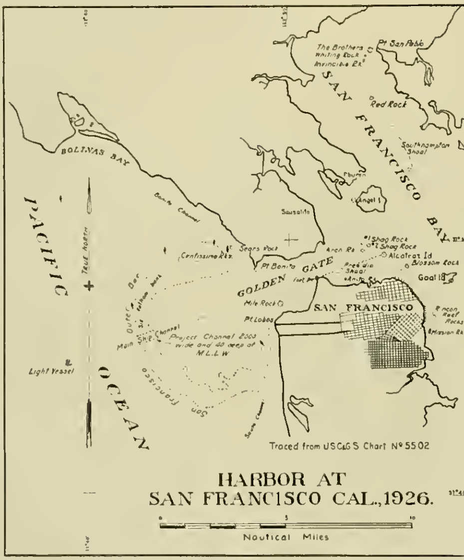
Harbor Improvements at San Francisco

The total Federal expenditures for the improvement of San Francisco Harbor and entrance have amounted to about $1,660,000. The first work of improvement was carried

out in 1870 and consisted of the removal of Blossom Rock, in San Francisco Bay, between Alcatraz and Goat Islands, to a depth of 24 feet; and of the removal, in 1875, of Noonday Rock, in the Pacific Ocean, about three miles northwest of North Farallon Island. This was followed in the first few years of the present century by the further removal of Blossom Rock to a depth of 30 feet and the removal to the same depth of Arch and Shag Rocks, lying about a mile northwest of Alcatraz Island. In 1910, a project was adopted for the removal of Rincon Reef Rocks, lying about one-half mile off the San Francisco waterfront at about Pier 30, to a depth of 35 feet, and for the removal of Centissima Rock, a serious menace which existed in the Bonita, or north, entrance channel, to a depth of 40 feet.

Present Project.

The existing project for San Francisco Bay, adopted in 1922 as a result of a preliminary examination and survey report made by the then district engineer, Colonel Herbert Deakyne, now Brigadier General and Assistant Chief of Engineers of the U. S. Army, provides for dredging the main ship channel across the outer bar, to a width of 2,000 feet and a depth at mean lower low water of 40 feet, with 2 feet overdepth. The length of the project channel is 8,000 feet.



HARBOR AT SAN FRANCISCO CAL.,1926.

To carry out the work of improvement, the seagoing hopper dredge "Culebra," which had been in the service of the Panama Canal and engaged in the construction of that important waterway, was purchased by the local engineer district in 1923, remodeled and placed on the work. This vessel was built at Sparrows Point, Maryland, in 1907, at an original cost to the Panama Canal of $341,577. The purchase price on transfer from the Panama Canal to the San Francisco work was $250,000, to which must be added the cost of transfer to San Francisco, about $43,500, and of extensive alterations and repairs made necessary to adapt the vessel to its present work, amounting to about $195,000. The vessel has a length, over all, of 288 feet and a molded beam of 47½ feet. The displacement is 3,230 long tons, light; and about 6,000 tons, loaded, the latter depending on the material dredged. The average draft is 13 feet, light; and 21 feet, loaded. The "Culebra" operates on the usual hydraulic suction principle for seagoing hopper dredges in the United States, with two drags, one on each side, which have a maximum dredging depth of 48 feet. Dredging is done by means of two 20-inch centrifugal pumps, direct-connected to two vertical, compound engines of 350 I.H.P. each. The vessel is equipped with two vertical, compound propelling engines of 1,000 I.H.P. each. The Scotch marine boilers, of which there are four, are oil-burning, the vessel having been converted from coal to oil burning after being brought to San Francisco. The fuel capacity is 2,004 bbls. of fuel oil, sufficient for almost two weeks' work and giving a cruising radius of 3,800 knots. The dredged material is carried in two hoppers, one forward and one aft, with total capacity of 2,240 cubic yards of material. The crew of the "Culebra" consists of 9 officers and 47 men, which comprises three 8-hour shifts. The average monthly field cost of operation of the dredge is approximately $19,500.

The entire work of dredging the ship channel across the San Francisco Outer Bar has been accomplished by the "Culebra." The work was begun in March, 1924, and completed in September, 1926. Work has been carried on continuously, 24 hours per day, except for periods of annual overhaul and for absence in the summers of 1924 and 1925 when the dredge was ordered sent temporarily to Grays Harbor, Washington, for emergency improvement work required to keep the entrance channel there open for navigation.

U. S. Army Dredge, "Culebra"

In general, work is practicable at all seasons of the year on the San Francisco Outer Bar, but there are certain periods when, due to storm or heavy seas, operations on the bar are not feasible. Fortunately, there has been important work to be done in the interior waters of the San Francisco Bay system, upon which the "Culebra" could be advantageously employed whenever rough weather interfered with the outside work on the bar. This fact has been of advantage to the San Francisco Bar work from the standpoint of economy, as it has avoided the expense of maintaining the dredge in idleness during bad weather periods when work on the outer bar was not possible. The principal interior work upon which the "Culebra" has thus been engaged has been the dredging of the 35-foot channel across Pinole Shoal in San Pablo Bay, under a project for San Pablo Bay and Mare Island Strait adopted by Congress in 1917.

A survey of the main ship channel across the Outer bar, made in September, 1926, indicates that the project channel across the bar has now been completed to its full project dimensions of 40 feet depth and 2,000 feet width, and that the additional permissible overdepth of 2 feet, to allow for deterioration and inequalities in dredging, has been obtained practically throughout the project channel. The work has been carried out under the direct supervision of Engineer F. C. Scheffauer, in charge of floating plant and dredging operations, under Engineer Geo. F. Whitemore, the principal assistant in charge of river and harbor work in the First San Francisco District. The work of improvement was initiated under Colonel, now Brigadier General, Herbert Deakyne, Corps of Engineers, who was relieved as district engineer by the writer on January 10, 1925. Captain George F. Stone is the master of the "Culebra" and has been in command of that vessel during the major portion of the operations on the outer bar.

The time consumed in actual dredging operations on the bar was 15 months. The average amount of material dredged from the channel per month was 258,651 cubic yards, and the maximum amount for any one month (September, 1926) was 439,774 cubic yards. The total amount dredged was nearly 3,900,000 cubic yards, which included maintenance during dredging and a considerable overdepth at completion, which will, of course, be offset by future deterioration.

The total expenditures for the improvement, including cost of dredge, dredging buoys, surveys, inspection and overhaul, was about $860,000. Deducting present value of plant, there remains properly chargeable to the work an amount of about $435,000, including depreciation of plant, but not interest. This is equivalent to a unit cost of about 11 1/6 cents per cubic yard. For the dredge operation proper, neglecting depreciation, the unit cost averaged about 7 cents.

The "Culebra" was withdrawn to other work on October 1, 1926. The deterioration of the bar channel will, it is thought, require about 2 to 3 months' maintenance work by the "Culebra" per year.

The improvement of the channel has resulted in a decided benefit to navigation. In August, 1926, the Battle Fleet, consisting of 11 dreadnaughts and about 57 smaller vessels, visited San Francisco Harbor and upon departure on August 30, 1926, made its exit for the first time through the newly improved channel. Except for the visit of a small part of the Fleet in San Francisco earlier in the year, it has been the custom heretofore for the large battleships to enter and leave by the north, or Bonita, channel.

Further Improvements Being Studied

The River and Harbor Act of March 3, 1925, authorized a further examination and survey of San Francisco Harbor to determine the necessity of further improvement. The improvements requested by local interests comprised the enlargement of the project for the main channel across the outer bar to 50-foot depth; the improvement of the north, or Bonita, channel by the removal of Centissima and Sears Rocks, on the northeastern edge of that channel, and by the dredging of the tip of the Four Fathom Bank, or "Potato Patch," opposite Point Bonita, so as to provide a channel 3,000 feet wide and 50 feet deep for the entire length of Bonita Channel; and the removal of certain rocks, shoals and wrecks in San Francisco Bay, including Blossom Rock, Arch Rock, Shag Rocks, Rincon Reef Rocks, Fort Point Ledge, certain rocks and shoals west of Alcatraz Island and in Raccoon Straits, Presidio Shoal, other shoals along the San Francisco pierhead line, a shoal at the mouth of Islais Creek, San Francisco, which locality is now being developed by the Board of State Harbor Commissioners and by a specially constituted reclamation district, and the wreck of the "May Flint" an iron sailing vessel laden with coal, which sank in 1902 at a point in the bay off Pier 32, San Francisco, and which was removed by the owners at the time to a depth of 35 feet. The preliminary examination report on the foregoing improvements was submitted to the Chief of Engineers, U. S. Army, at Washington, and by him referred, as required by law, to the Board of Engineers for Rivers and Harbors, a permanent body sitting in Washington, D. C. As a result of its study, the Board announced, on August 18, 1926, that it was not convinced of the advisability of the United States undertaking the further improvements requested in the outer channels of San Francisco Harbor at this time, as a channel 40 feet deep and 2,000 feet wide was being provided across the ocean bar at a location which was generally favored by interested parties in 1921 and no convincing reasons had been advanced, in the opinion of the Board, for abandoning the main ship channel project and improving Bonita Channel or for improving both channels. As to the inner channels of the bay, the Board recommended and the Chief of Engineers has ordered a survey of a channel 2,000 feet wide and 35 or 40 feet deep, extending from the Golden Gate to and along the main San Francisco waterfront, as well as a survey of Blossom Rock to the same depths. This survey will embrace Blossom Rock, Presidio Shoal, minor shoals in front of the San Francisco pierhead line at Black Point and near Piers 35 and 37, Rincon Reef Rocks, and the wreck of the "May Flint." The Board was not convinced of the necessity for the several other isolated items of dredging or rock removal proposed by various interests, but interested parties have been invited to submit further statements and arguments in the interests of commerce and navigation, bearing upon the necessity of the improvements for which surveys have not been recommended.

In the meantime, a separate report has been submitted on the dredging of the shoal at the mouth of Islais Creek, under authority of an older act of Congress, that of June 5, 1920. As a result of this examination and survey, the Chief of Engineers, on April 1, 1926, recommended to Congress that the existing project for San Francisco Harbor be modified by the dredging, to 34-foot depth at mean lower low water, of a flared entrance channel through the portion of the shoal channelward of the United States pierhead line near the mouth of Islais Creek, and of the shoal area adjacent to and immediately south of such flared channel, at an estimated first cost of $146,000 to the United States, if done by Government seagoing hopper dredge, and with an estimated annual maintenance cost of $25,000. The recommendation is contingent upon certain items of local co-operation, including the dredging by the State of the Islais Creek channel from the United States pierhead line to the vicinity of the existing State terminals on Islais Creek. Local interests, if they desire the work done by hydraulic pipeline dredge and the material deposited ashore for reclamation development, may do so by contributing the excess cost involved in dredging by this method above the estimated cost of doing the work by Government seagoing hopper dredge. The first element of the work undertaken would be the deepening of the flared approach channel, the remaining area to the south not being dredged until such time as, in the opinion of the Secretary of War and the Chief of Engineers, such work shall be rendered necessary by additional terminal developments along the bay front.

Other Improvements in the San Francisco Bay Region

In addition to the work of improvement for San Francisco Harbor proper, the United States is engaged upon works of major importance at other sections of the San Francisco Bay District. Three other projects include the dredging of a 30-foot channel in the inner harbor at Oakland, a 24-foot channel at Richmon, a 35-foot channel across Pinole Shoal

(San Pablo Bay) and in Mare Island Strait, and of channels of depths varying from 18 to 24 feet across certain shoals in Suisun Bay. The United States also has under improvement certain tributary waterways to the San Francisco Bay system, including Petaluma Creek, San Rafael Creek, Napa River, and Suisun Channel, to say nothing of the important Sacramento and San Joaquin Rivers. These latter two are in the territory covered by the Second San Francisco District, of which Major C. S. Ridley, Corps of Engineers, is district engineer.

Commerce of San Francisco Bay

The commerce of San Francisco in the past few years has shown a marked increase. For San Francisco Harbor proper, this commerce has grown from about 7,700,000 tons in 1920, with a value of $775,000,000, to approximately 12,000,000 tons in 1925, with a value of nearly $1,200,000,000. This is an increase of more than 50% in five years. The growth of commerce for the Bay system as a whole, however, has been even more marked. The commerce passing through the Golden Gate in 1920 amounted to about 10,000,000 tons; in 1925, to about 28,000,000 tons. This comprises, of course, commerce going not only to San Francisco Harbor proper, but to Oakland, Richmond, San Pablo Bay, Mare Island Strait, Carquinez Strait and Suisun Bay. Adding to this Golden Gate commerce the interior tonnage carried on the bay and river system, about 10,000,000 tons per year, there is a grand total of commerce for the San Francisco Bay system as a whole, during 1925, of about 38,000,000 tons, which is approximately one-third greater than the commerce passing through the Panama Canal the same year.

Entrance to San Francisco Bay As Charted By Spanish Explorers in the Year 1776.

The Importance of Sound Engineering to the Economic Development of Central California

By Dr. B. M. Rastall
Manager Californians Inc.

One outstanding difficulty confronts the man who would discuss, before an audience of engineers, the importance of engineering in the development of central California—the difficulty of avoiding what might seem to be fulsome praise. But praise is in order, and I am willing to take the risk. It has always seemed to me that engineers are a singularly modest lot, or, at any rate, that they do not get the measure of public attention and appreciation that is their due. We take their most extraordinary exploits for granted, and as a race we are too apt to pat ourselves on the back for achievements that are the work of a very small group of men.


Dr. B. M. Rastall

From the earliest times, California development has called for engineering works on a large scale. Unlike many states in the East and Middle West, California has built its communities not on the aggregate achievements of a great number of men working each by himself, but on enterprises that require co-operative endeavor on a large scale. They had to be large and they had to be co-operative because they involved large-scale engineering. Mining on the Mother Lode had not been in progress for five years after 1849 before the crude panning and rocking of gravel began to give way to flumes that called for larger and larger expenditure of capital and engineering skill. Streams were tapped far up in the mountains, and water was diverted and carried for many miles to the sluice-boxes. One of our greatest hydro-electric corporations, a corporation today serving scores of cities and more than a million consumers, had its beginnings in one of these early-day water companies organized by and for the miners of the days of gold.

Hydraulic mining marked another step in the application of engineering skill to the extraction of gold. Then interest shifted to the national dream of a transcontinental railroad. Again California threw a challenge to the engineer, and again the challenge was met. The conquest of the high Sierra by the giants of the Sixties stands out as a victory for faith and daring and skill. We have but recently lost the Dean of the old guard, whose record is written in a hundred difficult grades and tunnels, who pioneered where thousands now pass thoughtlessly in their Pullmans unconscious of their debt. The Lucin cut-off, the Tehachapi loop, the road over the Siskiyous, the newer line through Cariso Gorge,—these are monuments to William H. Hood, and they are achievements of which the entire engineering profession is proud.

The rails conquered our mountains, and California rested on that accomplishment. Our great valleys were given over to wheat and cattle. Growth in population and wealth was slow. Many years were to pass before anyone realized that orchards and dairy farms would justify engineering works of a magnitude undreamed of in the early days.

It would not be too much to say that California as we know it today began only a short generation ago, and that its beginnings were contemporaneous with and dependent upon the development of hydro-electric and irrigation engineering on a large scale. The man on the street little realizes what he owes to the miles-long tunnels through the Sierra, the monumental dams, the generating plants with their great turbines,—all hidden away in the mountains and sending out their wonder-working current in transmission lines that are the marvel of the engineering world. Men come from New York and Buffalo, from Europe and South America and Australia, to study the accomplishments of our hydro-electric engineers. Pioneers in long-distance transmission and in other branches of

the science, not only California but the world is their debtor.

Our obligation here in California cannot be exaggerated. There would be no towering sky-scrapers on Montgomery Street today; the hammer and the riveting-machine would not resound throughout the city; there would be no growth at a rate that will double our population in a ten-year period, were it not for the engineers who harnessed the waters of the high Sierra, used them for the generation of power, and delivered that power in great volume and at low price to our valleys and cities. And there would be no market for the power were it not for these same engineers and their colleagues, who impounded and conducted for hundreds of miles the pure mountain water on which the life of orchards and crops, live stock and industry, human life itself, depend.

So it is that in a peculiar sense California owes a debt to engineering over and above the debt of other modern communities. Without engineers of the most skillful, supported by large aggregations of capital and efficient business organization, California would have remained to this day a comparatively primitive community of wheat-growing and cattle-raising. As mining fell off, our cities would have decayed in importance, and community life might have been charming, but it would have been stagnant too. California's engineers can point to valley after smiling valley filled with prosperous and contented families, each increasing the world's share of fruits and staples, and say, with modesty enough and likelihood to follow: "That is our work!" It is owing to them that Californians Inc. can truthfully broadcast the slogan, "California, Where Life Is Better." Without them we should have nothing to offer the easterner with energy and capital who is anxious to share our life and add to our wealth.

When we consider in detail the development of the State and City, the engineer's part looms large at every turning. There is the comprehensive development of harbor facilities. There are the bridges, already built and building, and the greater bridges that in some early day must span the Bay and integrate our metropolitan district. There are the ambitious and daring projects of San Francisco and Oakland, the former already reaching consummation, that will provide an adequate supply of pure water for the millions of the future. There is the work of our highway engineers, who have robbed grade after grade of its terrors by building roads that are beautiful examples of the latter-day progress of this ancient art. Nor must we neglect appreciation of what has been done by the generations that preceded us. You cannot drive along the Skyline Boulevard past the beautiful lakes that provide San Francisco with an excellent quality of water without thoughts of admiration and gratitude for the engineers who planned and executed, and today maintain, this essential utility.

Here in San Francisco the engineer has played his part, and his work has only begun. My first San Francisco task was the preparation of a San Francisco program looking to the best social and economic development of our great metropolis. And in that program I had need to incorporate several major projects of a distinctly engineering nature. The draining of Islais Creek and the reclamation of its shore lands; the removal of Rincon Hill; the laying out of new through streets; the breaking down of natural obstacles to the city's growth by boring tunnels and cutting roads,—these are only a few of the essential enterprises for which we must depend upon the engineering profession.

In conclusion may I express my sincere envy of men whose jobs are constructive in the primary meaning of that word. No winds of theory and controversy obscure the absolute and indisputable usefulness of their tasks. Working with relatively meager pecuniary rewards, their great compensation is the consciousness of a positive contribution to human betterment. Life more abundant is their day-by-day gift to the community.

Harbor Improvements for the Port of Oakland

By G. B. HEGARDT
Manager Port of Oakland

The importance of rail and water terminals and systematic harbor improvements is now a generally recognized principle of port development and demands an intensive study and a broad gauged planning of new and the reconstruction of existing facilities to insure the successful administration and operation of a modern port, with the view of attracting and retaining the flow of domestic and foreign commerce.

The modern ocean liners of large carrying capacity demand adequate channel depths and improved port facilities at which cargo can be handled in such an economical and expeditious manner that regular schedule of sailings may be maintained and the same dispatch supplied to water-borne commerce as is being furnished by land transportation, thus establishing an express service which enables the shipper and the purchaser to determine, with a fair degree of accuracy, the arrival of their goods at destination almost to the day and hour.

The completion of the Panama Canal greatly intensified port activities on the Pacific Coast of the United States, and extending to British Columbia ports, which have been immensely benefited thereby, and its greatest development has taken place since that time in agriculture, in horticulture, in industry and in all agencies engaged in transportation.

The agitation for the provision of modern and adequate port facilities to care for the increased commerce expected from the opening of the Panama Canal began as early as 1910 and extended from San Diego to Van couver and Prince Rupert on the north. Every port of consequence along this 1500 miles of coast line appealed to the voters of their districts, or State or Federal authorities, for authority to issue bonds to meet this new situation, and in this they were universally successful. The feverish activity in construction and the large sums of money expended for this purpose during a period of about ten years probably has never been equalled in any other section of the country. Reference is made to such ports as Vancouver and Victoria, B. C., Seattle, Tacoma, Portland, Astoria, Los Angeles and San Diego. San Francisco, as the most important port on this coast was, however, so well known and established at that time that it was merely a matter of continuing is expansion at an accelerated rate to meet the demands of its rapidly increasing water-borne commerce, and we are all familiar with the successful way in which this has been accomplished. This was really the first time that the people of the majority of the Pacific Coast ports had become "Ship-minded," but it was effective and has been lasting.

With the commerce made possible by the Panama Canal route, the shipping with foreign countries also developed at a rapid rate until a large number of steamship lines now maintain regular sailings to most of the ports referred to and as ports of call of others, thus providing an outlet to foreign markets of the products of the territories tributary to these ports and the trans-shipment of goods through them.

The one single exception to this concerted movement among the major ports along the Pacific Coast for the development of its harbor was Oakland, and it was not until late in 1924 that definite steps were taken by its citizens to issue a call for a comprehensive study and plan for the building of a modern port, which would adequately serve its large and diversified industrial and manufacturing interest and the producers in the vast valleys which constitute the hinterland of the port.

This activity was initiated by the appointment of a Board of Consulting Engineers, composed of Professor Marx, of Stanford University, Colonel Leeds, of Los Angeles, and the writer, who, after an extensive study and consideration of all the factors and elements entering into the creation of Oakland as a port of major importance, submitted a report delineating its development along comprehensive and definite lines. This report, which was submitted to Mr. Leroy R. Goodrich, Commissioner of Public Works, in September, 1925, made recommendations as to the port development which should be immediately undertaken and as to the subsequent improvement of the port, following the completion of the immediate construction work.

Based upon recommendations and conclusions contained in this report, the amount of $9,960,000.00 was voted by the electorate in November of that year to cover the cost of the immediate construction program, which included two double piers in the Inner Harbor of a length of approximately 600 feet each,

with transit sheds 150 feet wide, at a cost—with necessary trackage, roadways and approaches—of about $2,664,600.00; a quay wharf in the Outer Harbor—Key Route Basin—1700 feet long and transit shed 1500 feet long and 180 feet wide, estimated to cost—with trackage and roadways—$1,470,000.00; and in the Brooklyn Basin—Inner Harbor—a double pier 1700 feet long, with transit sheds of the same length and each 180 feet wide. This large pier, with approaches, roadways and trackage, is estimated to cost $3,820,-000.00.

The above enumerated facilities will provide combined berthing space of 7700 lineal feet and transit shed area of 1,164,000 square feet. The type of construction adopted will be concrete substructure, except aprons carrying the railroad tracks, which will be of creosoted piles. The transit sheds will have wooden frames and concrete sides and be rat proof.

At the quay wharf in the Outer Harbor, provision has been made for the installation of a shearleg with a lifting capacity of 100 tons, and at the Grove Street Pier—Inner Harbor—for a 50-ton shearleg.

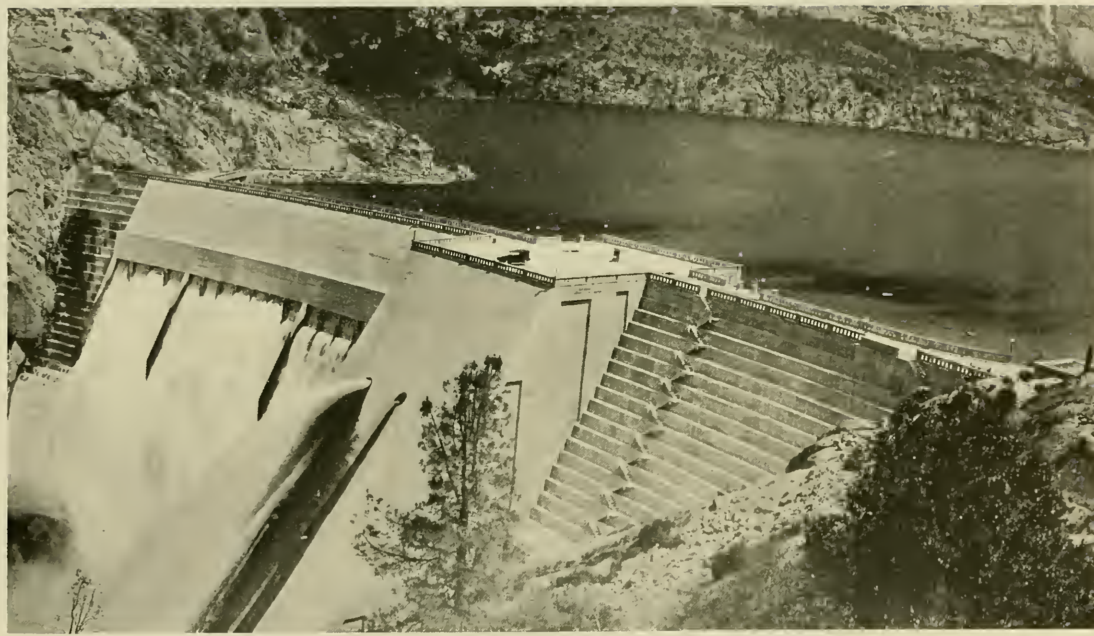
In addition to the above, the $9,960,000.00 bond issue provides for the construction of warehouses and a cold storage plant, a fire boat, an extensive dredging program and miscellaneous construction items. Under this latter head there will be constructed, in the Inner Harbor, a barge and river steamer terminal, with two transit sheds 100 feet wide and 300 feet long.

Of the $9,960,000.00 authorization, $2,000,-000.00 worth of bonds have been sold, to cover the contract work which will be under way this year. The contract for 1000 feet of the substructure of the Outer Harbor quay wall—Fourteenth Street Wharf—was let in August and bids for the substructure of the Grove Street Pier—Inner Harbor—will be opened on November 4th. The transit sheds for these improvements will be built under separate contracts. With these larger construction items disposed of, the preparation of the plans for the barge and river steamer terminal will be taken up, and it is expected contract for this will be let before the end of this year.

Before actual construction can be commenced on the 1700-foot long double pier in Brooklyn Basin, it will be necessary to come to an understanding as to the acquisition of Government Island, in Brooklyn Basin, the jurisdiction of which, by decree of the State Supreme Court, was awarded to the City of Alameda. Negotiations to this effect have been under way for some time and it is expected that an agreement transferring the island to the City of Oakland will be consummated in the near future.

Oakland is fortunate in owning or controlling the greater portion of the waterfront of its extensive harbor, which enables it to expend most of its bond funds for actual construction work, for the acquisition of sites for the authorized and contemplated harbor improvements would represent a very heavy expenditure of money.

One must be impressed with the tremendous possibilities, actual, latent and potential, which can be readily put into service by the contemplated improvement of Oakland Harbor. With the greater coordination of its rail, highway, river and ocean transportation agencies, and the completion of its development program, it is confidently expected the Port of Oakland will take its rank as one of the major ports of the world.



The O'Shaughnessy Dam.

Hetch Hetchy Water Supply Project

By M. M. O'Shaughnessy
City Engineer

Introduction

The City and County of San Francisco has under construction the Hetch Hetchy Water Supply, a system that impounds the melting snows of the high Sierras and will bring from them to San Francisco sufficient water to satisfy the future needs of four millions of people who will dwell on the peninsula. The drop of the water from mountains to lowland will be utilized in three major power plants, one of which is already in operation, to generate over 250,000 horsepower of electric energy to furnish light and power to the City.

Two divisions of the project have been completed and put in operation: the Mountain Division, with reservoirs, tunnel aqueduct and power plant bringing the City a gross annual revenue of over $2,300,000; and the Transbay Pipe Line, operating under agreement with the Spring Valley Water Company for $250,000 yearly rental, bringing in sufficient water to satisfy our needs until our own aqueduct shall have been completed.

Watershed

Waters from melting glaciers and snows off a watershed of 420,000 acres of bare granite mountains in the northerly part of Yosemite National Park are impounded in two main reservoirs, Hetch Hetchy, at elevation 3720 feet above sea, and Lake Eleanor, at elevation 4660 feet. The highest peak on the eastern crest of the watershed is Mt. Lyell, at elevation 13,090 feet. Over 90 per cent of the catchment area is above 6,000 feet elevation. Its ownership is vested practically entirely in the Federal Government as part of the Yosemite National Park, or in the City and County of San Francisco. This will forestall any possibility of future contamination of the water by industries, such as farming, cattle raising, lumbering, mining, etc. Owing to its extreme elevation and rocky character, the area is uninhabitable for all but three months of the year. If necessary, strict sanitary regulations could be enforced by the National Park Rangers. It is difficult to conceive of a more ideally safe gathering ground. With closed conduit, either pipe or tunnel, all the way to San Francisco as is at present under construction, it is not necessary to plan any treatment of the water: filtration, aeration, chlorination, or any other dosage may be entirely dispensed with.

The extreme softness of Hetch Hetchy water, compared to other waters in California, is well shown in the following tabulation, based on testimony of Allen Hazen before the Board of Army Engineers of 1912 and analysis of Hetch Hetchy reservoir water in 1925:

Source of Water	*Hardness as parts per million calcium carbonate*
Spring Valley Water Company, average	100
San Joaquin River at Lathrop	90
Sacramento River above Sacramento	55
Tuolumne River at La Grange	40
Hetch Hetchy Reservoir	2.58

A roughly approximate financial estimate of the value of the low hardness of Hetch Hetchy water against the high hardness of the average water supplied to San Francisco by Spring Valley Water Company, based on ten cents for each part per million and assuming a supply of 50 million gallons daily as at present, amounts to $487.50 per day, or $178,000 per year in favor of Hetch Hetchy, which represents 5 per cent interest on an investment of over $3,500,000. With 400 million gallons daily ultimate consumption, this amount will increase to $28,000,000.

Mountain Division

Hetch Hetchy Reservoir was created by building a dam across the Tuolumne River at the outlet of Hetch Hetchy Valley. This dam, named O'Shaughnessy Dam, is the largest unit structure in the West. It contains over 396,000 cubic yards of concrete, is 600 feet long at the present crest, and 298 feet thick at the river level. Its height is 344½ feet, being 226½ feet above river and 118 feet below river. It consists of six blocks separated by contraction joints sealed with sheet copper. Draft of water from the reservoir is made through twelve outlet valves, six of them being five feet in diameter and six of them three feet. Flood waters are passed through eighteen siphon spillways of 20,000 second feet aggregate capacity. The cost of the dam, clearing reservoir, etc., etc., was about $7,000,000. Work was begun in August, 1919, and completed in March, 1923, in time to fill the reservoir from that season's runoff. The runoff from the river is ordinarily sufficient to fill the 67 billion gallon reservoir twice in any month of June. At some future date the reservoir capacity will be increased to 113 billion gallons by adding 85½

feet to the height of the present dam. The foundation for this ultimate dam has already been constructed.

Lake Eleanor Reservoir, created by building a buttressed concrete arch dam 70 feet high, 1260 feet long, across Eleanor Creek, a branch of Cherry River, which in turn empties into the Tuolumne River, impound 28,000 acre-feet or 9 billion gallons. In the future this storage will be increased to 71 billion gallons by the construction, on the downstream side, of a rock fiill dam 235 feet high. With Hetch Hetchy and Lake Eleanor reservoirs of their present capacity, enough water is developed for a population of one and one-half millions of people. Future demand for water and power will be met by raising these structures.

The water released from Lake Eleanor now flows down the natural channel of Eleanor Creek and of Cherry River about eight miles, where it is diverted into an aqueduct $3\frac{1}{2}$ miles long which brings it to Early Intake, 12 miles below Hetch Hetchy on the Tuolumne River and distant 156 miles from San Francisco. In a similar manner the water from Hetch Hetchy flows down the Tuolumne River bed a distance of 12 miles to Early Intake diversion dam. Eventually the waters will be brought to this point in tunnels and passed through two power houses developing 100,000 horsepower of electric energy.


M. M. O'Shaughnessy

Early Intake is the beginning of the aqueduct. Here a simple arch concrete diversion dam 400 feet long, 81 feet high, with crest elevation of 2356 feet, was built at a cost of $600,000. The spillway, 130 feet long, of 20,000 second feet capacity, consists of five automatically operated radial gates five feet high, so designed as to lower at flood time and normally hold the level of water elevated to greatest height at the tunnel intake. On the south bank of the river above the dam is a concrete gatehouse containing screens and nine sluice gates 4 feet by 5 feet which regulate the flow into the tunnel aqueduct which begins here at elevation 2326 feet.

Mountain Division Tunnel from Early Intake to Priest Portal is 19 miles long. The first seven miles, driven through hard granite, is 13 feet 6 inches by 13 feet 4 inches and is unlined except for a few short stretches. The remaining 12 miles, driven through softer rocks, is lined with concrete in a horseshoe shape to a clear diameter of 10 feet 3 inches. At mile 5 the aqueduct crosses South Fork of Tuolumne River as a steel pipe 9 feet 6 inches diameter, $225\frac{1}{2}$ feet long, built as a continuous beam of four uneven spans, the longest 74 feet, supported on concrete piers.

The daily capacity of the tunnel is 500 million gallons. It was completed in 1925 at a cost of $10,000,000. The westerly end of the tunnel is at elevation 2170 feet or 70 feet below high water of Priest Reservoir.

Priest Dam forms a regulating reservoir for the operation of Moccasin Power House. The dam is earth fill with rock fill toes. The upstream portion of the earth fill was deposited by hydraulic methods, the downstream portion by steam shovel and train, and then jetted against the core wall. A jointed core wall of concrete 160 feet in height extends well into bedrock along the axis of the dam. Crest elevation is 2245 feet, flow elevation 2240 feet, length 1160 feet. The dam is 145 feet high, contains 717,283 cubic yards of rock and earth fill, 17,043 cu-

bic yards of concrete core wall and cost $1,000,000.

An auxiliary outlet tunnel, six feet in diameter, lined with concrete, passes through the rock under the easterly end of the dam. The main outlet from the reservoir is the "Power Tunnel" 13 feet diameter, lined with concrete of 9 inches minimum thickness, 5370 feet long to a surge shaft 535 feet from the west portal, 40 feet diameter, 160 feet high, where three penstock tunnels begin. Each of these tunnels contains a riveted steel pipe line 104 inches diameter, imbedded solid in concrete.

Penstock Pipes: One of the penstock pipes is capped beyond the butterfly valves at the end of the Power Tunnel, to be extended in the future to supply two additional generating units in Moccasin Power House. The other two pipes continue 8 feet 8 inches diameter for 2000 feet and then branch to four pipes 5 feet 6 inches diameter, reducing and branching again at the power house to eight 3-foot pipes with nozzles 11 inches in diameter.

Moccasin Power House contains four generating units, each consisting of a generator with double overhung impulse water wheels operating under a static head of 1316 feet. The total rated capacity of the plant is 80,000 KVA, or 100,000 horsepower, practically equivalent to the total amount of power used in San Francisco. It is planned to increase the installation in this plant by adding two more generators and extending the building at the south end when the other two major plants at North Mountain and Early Intake are built. This will make the installed capacity 250,000 horsepower.

The power is generated at 11,000 volts, stepped up to 120,000 volts for transmission, switched through an outdoor switchyard and transmitted 98½ miles over the City's transmission lines to a point near Newark on San Francisco Bay, whence it is brought into town and distributed over the lines of the Pacific Gas & Electric Company. The City's income from power sales, based on meter readings at Newark, is over $2,300,000 per year.

The transmission line, designed for 154,000 volts, consists of two circuits of three wires each. Aluminum cable is used in the inland region to Sunol and copper cable near the Bay, where fogs are often encountered. The towers are of galvanized steel generally 97 feet high.

Foothill Division Tunnel

This tunnel, extending from Moccasin Power Plant to the edge of the San Joaquin Valley, a distance of 17 miles, will carry the water from a regulating reservoir at the power house to the pipe line across the San Joaquin Valley. This tunnel is of the same section and on the same grade as that already completed in the mountains and will have a capacity of 500 m.g.d.

Construction work has been in progress for about a year, the maximum force being 650 men. Two miles of tunnel have been drifted by day labor forces under the direction of the City Engineer. Contracts have been let recently for half the tunnel work, while the remainder will be continued by day labor.

San Joaquin Valley Pipe Line

This division is not yet under construction, but will be begun at such time as to be completed at the same time as the Coast Range Tunnel. The City owns a strip of land 110 feet wide, 45 miles long, across the valley. The present transmission line occupies the northerly edge of this strip. The future transmission line will be along its southerly edge, while the central portion will hold three pipe lines about 7 feet diameter.

Coast Range Tunnels

These will extend from the west edge of the San Joaquin Valley through the Livermore hills 29 miles to Irvington, near San Francisco Bay. Diamond drill borings completed recently have shown favorable tunnel drifting ground. Work will be begun shortly, sinking five construction shafts along this tunnel line. As a construction job, this tunnel will take about four years to complete, provided that funds are adequately provided.

Bay Development Pipe Line

The division from Irvington, Alameda County, to Crystal Springs Reservoir in San Mateo County, a distance of 21 miles, has been put into complete service and is now carrying 34 m.g.d. of Spring Valley Water Company water. The line was built and leased to the Company pursuant to an agreement with the City dated April 17, 1922, and is expected to carry sufficient water for the City's use during the time of completion of the Hetch Hetchy Aqueduct. The Company pays the City an annual rental of $250,000 for the use of this conduit.

This division consists of 19.5 miles of 5 foot diameter riveted steel pipe, 0.5 mile of 42-inch diameter cast iron flexible joint pipe under San Francisco Bay and 1.7 miles of 10-foot 3-inch diameter concrete lined tunnel through Pulgas ridge, with a concrete open canal outfall structure 906 feet long.

This steel pipe is carried over the salt marsh on both sides of the Bay on a pile trestle. Across the shallow portion of the Bay is a steel bridge 3870 feet long on concrete piers. The easterly pier provides connection from the sub-

marine pipe to the steel pipe. It is a caisson 73 feet in diameter and 73 feet deep, resting on 715 piles and containing 527 tons of reinforcing steel. Provision is made for connecting to three future submarine pipe. The steel birdge is designed to carry two pipe 6 feet 4 inches in diameter.

Distribution System

To distribute Hetch Hetchy water it is planned to buy the Spring Valley Water Company's system, on which the City now has an option at $38,000,000 which expires December 31, 1933. By this purchase the City would acquire ownership of all structures, over 60,000 acres of land, a distribution system with a service in every household and ample reservoirs near San Francisco which could be kept filled with pure mountain water. The purchase price could be paid for out of the system's earnings.

City Reservoirs

The distribution reservoirs of the Company inside the City hold but three days' supply for the City. Without doubt this would not be sufficient in the event of a repetition of the disaster of 1906. This office has been for the last few years advocating increasing this storage to four weeks' supply. This could be done by building the Amazon Reservoir, the main receiving reservoir of the Hetch Hetchy Aqueduct, of capacity 350 million gallons at elevation 250 feet; the Glen Park Reservoir, of capacity 500 million gallons at elevation 385 feet; and the Balboa Park Reservoir on Water Company land, capacity 280 m.g. at elevation 320 feet.

Conclusion

The two ends of the project are complete, the mountain end bringing in an income sufficient to pay maintenance, operation ad interest on the entire project, while the bay aqueduct brings in sufficient water to tide us over until such time as the main aqueduct is completed and bringing in mountain water. At the rate that the City is now growing, the aqueduct can just be completed before its present sources are exhausted. Therefore, the water construction may be regarded as the most important improvement now before the people of San Francisco.

San Francisco in 1862—Looking east from Telegraph Hill

SOCIETY *of* ENGINEERS

Regular meetings are always held the second Tuesday evening, each month
Blue Room, Palace Hotel

Secretarial Office
952 Pacific Building, San Francisco
Telephone Sutter 5819

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Louis F. Leurey, 1924
Volney D. Cousins, 1925
*Reorganized Oct., 1925.
C. H. Tucker, 1925

*Formerly San Francisco Chapter, American Association of Engineers.

Concerning Active Work of the Society

By Glen B. Ashcroft
President

The Society of Engineers is not a technical organization in the interpretation usually placed upon these words when we are thinking of technicians. Devoted to the interests of professional engineers it holds within its rank men skilled in all branches of the profession. It seeks by all legitimate means to acquaint the general public with the work and worth of the engineer and to obtain a suitable recognition for the services he has given to society. Giving to its members an opportunity for the study of public and economic problems, and training in self expression, it seeks to qualify the engineer for a more definite position in the public eye.

To the young man who is just starting out in his career the Society extends to him the opportunity of meeting brother engineers on a common ground. By serving on committees and taking an active part in other group activities he can acquire a facility for team work and become interested in public affairs, and thus become useful in fulfilling the obligations he owes to the profession as well as fulfilling his duties as a citizen.

After reviewing the work of the Public Affairs Committee I am prompted to select one subject of its investigations and write in the interest of its accomplishment:

Glen B. Ashcroft

In 1921 there was created by our Legislature the Mt. Diablo State Park. One of the plans of the Commissioners for the further adornment of this natural beauty spot contemplated the erection of a permanent survey monument at the summit. On the peak of this mountain and at an elevation of 3449 feet stands the initial point of the Mt. Diablo Base and Meridian, lines upon which are based the public land surveys of the greater portion of California and all of Nevada. This initial point, being in proximity of Latitude 38°, Longitude 122°, was established at a very early date in State history by a pioneer engineer, Col. Leander Ransom. The Public Affairs Committee suggested to the Mt. Diablo Park Commission that it would be most appropriate if in the design of the monument provisions could be made for a tablet suitably commemorating the services of Colonel Ransom, also as a tribute to the memory of pioneer engineers for the work they contributed to the orderly development of the State. This suggestion met with favor and the monument was designed accordingly by Mr. J. J. Mora. Its erection, however, must await action by the next legislature to appropriate necessary funds for further improvement work.

The Committee in the course of its investigations was able to locate a daughter of Colonel Ransom, Mrs. Amelia E. Neville, now more than eighty years of age and living in a northern state. Through the courtesy of Mrs. Neville there were obtained many facts relating to the life and work of her father, and among other facts it was learned that he was a Charter Member of the California Academy of Sciences, its President for several terms, and an ardent supporter of the organization until the time of his death in 1874. He is buried in Laurel Hill Cemetery, San Francisco.

Mrs. Neville forwarded to the Committee for its inspection some of the personal correspondence of her father, a part of which, in particular was a "letter book" written in 1852 by Colonel Ransom to his family. Here a trip of exploration to the summit of Mt. San Bernardino in Southern California was described, accompanied by an original pencil sketch of the Mission San Luis Rey. Recognizing the historical value of this document the suggestion was made to Mrs. Neville that

it should be preserved and made available to access of future historians, and through the efforts of the Committee and the generosity of Mrs. Neville this letter and other data relating to Colonel Ransom have been placed among the prized collections of Bancroft Library at the University of California.

In the latter part of the year 1851 Colonel Ransom, then 50 years of age, a successful engineer and Deputy United States Land Surveyor, established the initial point of the Mt. Diablo Base and Meridian and ran a portion of its lines. In later years these lines were extended by other Deputy Surveyors. From the initial point on the summit of the mountain this Base Line runs eastward more than 400 miles, across the broad plains of the San Joaquin Valley, over the rugged peaks of the higher Sierras, touching the edges of Yosemite and Mono Lake and onward across the plateau of Southern Nevada to the western boundary of the State of Utah. Westward it runs to the shores of the Pacific Ocean; northward runs the Meridian Line to the southern boundary of Oregon and southerly to Monterey Bay, a total of more than 800 miles. Upon these lines are found public land surveys of more than one hundred and thiry-six million acres.

As long as man bargains in land the Mt. Diablo Base will be known and remembered, but what of the memory of the early engineers who labored to establish an identity of these lands for the benefit of future generations? Seventy-five short years have served to almost obliterate the record of the activities of these men and their problems of early construction work.

The official records of the early engineers are extremely brief. It requires imagination to appreciate some of the hardship and dangers that went hand in hand with their daily tasks. Occasionally a short sentence discloses a prophetic vision of the future, or a concise note concerning something of the personal self sacrifice made in order to accomplish their allotted work in a creditable manner. From the field notes of A. A. Von Schmidt, who ran a portion of the line in the vicinity of Mono Lake, we find

"The within * * * were run between August 9 and September 8, 1857, it being impossible to keep exact dates as we had to work in a body to the best advantage, on account of the number of Indians about us. The work during the season had to be carried on by two parties working close together for each other's protection."

Do we often pause as we move about in ease and comfort on our highways, and think about the dangers and difficulties involved in early-day travels? It is difficult to realize that within the short span of a man's lifetime a trip from the Golden Gate to Sacramento involved an eight days' journey.

We should honor and respect the memory of these early-day builders. Unwitting agents of an inscrutable Providence, adventurous spirits of the wanderlust, they came that waste spaces might be reclaimed, the ways made straight, and the paths made easier for the thousands that come after them. Some of better fibre than others, some perhaps with a more conscious and clearer vision as to the value of service they could render to future people.

Where is the artist whose brush can picture, or the writer whose pen can describe, the struggles of our early engineers who blazed a trial through dense forests, forded rivers, scaled rocky canyon walls, and fought Indians, that the outposts of civilization might be advanced a little farther into a trackless wilderness? But such work is the necessary forerunner of progress and development and shall endure as long as men live in civilized communities.

It is desirable that the public conscience be awakened to the work of the Engineer and the vital part that work plays in the orderly functioning of society. Let us then, before it is too late, rescue from utter oblivion something of the personal history of these men and have it duly recorded. Let us have at Mt. Diablo this monument, dedicated to the memory of those earnest, conscientious, loyal citizens whose labors laid the foundation lines for the systematic progress of an Empire, those heretofore almost forgotten heroes—OUR PIONEER ENGINEERS.

An industry depending upon one of the arts has problems which arise in most of the other arts. A man having experience in one industry may be able to cope with most of the difficulties which arise in that industry, but very likely is unable to translate principles of one art into the principles of even kindred arts. The engineer is particularly trained in this kind of translation because he is able to give each industry the best that has been found by all other industries. — ENGINEERING-NEWS RECORD.

Human Engineering

By William S. Wollner
Past President 1920
General Safety, Fire Prevention & Welfare Agent
Northwestern Pacific Railroad Co.

The professional engineer's schooling is more largely with the materials of construction and what may be done with them. He is taught very little about the means of application which in large measure means the human element ingredient in the construction program. When he becomes actively involved in engineering work, the engineer, particularly the younger one, finds that the human element phase of his work is largely taken care of by the contractors to whom the work is entrusted. It is not infrequently true that the principal himself will furnish the materials of construction or surround their provision with rigid specifications while the labor element of the project will not be touched upon other than to state in some form that the labor must be performed in a workman-like manner.

The recruiting of the working force, its training and supervision is left entirely in the hands of the contractor and the engineers representing the principal take no more than a passing interest in its quality or make-up provided that this is not such as to interfere with the completion of the job as required by the contract and specifications. But as the engineer advances in his profession, taking on executive responsibilities, he learns that as between men and material the former is by far the most important part of any project or operation. He finds that he must interest himself in the availability of labor, the relative efficiency of various kinds of men, their re-action to various conditions and surroundings, etc., and he ultimately decides that while it is easy to find engineers who can calculate stresses and strains, who can survey and map, it is very difficult indeed to find those who fully understand the human element phases of construction and industrial management.

William S. Wollner

So important has human engineering been found that it has been subdivided into various components, and while in some cases the entire field is covered by a single individual, in larger concerns the components are each handled by a different person. Some of these components will be treated under separate headings in this article.

Employment

It would seem peculiar to find a man operating under the title of "employment engineer," but it is not uncommon to find professional engineers who are devoting their time to the conduct of employment departments or employment bureaus in large organizations. The reason why the professional engineer is peculiarly successful in this line of activity is that he is familiar with the operations for which men are being employed. If his early experience has not familiarized him with them, his training has been such that he easily acquires a knowledge of what is expected of the men he is employing and he can devise tests to determine their fitness for the work in hand.

The employment department frequently includes among its functions housing, sanitation and similar problems, and the engineer finds this an easy matter to handle due to his training in details of construction. The engineer is also peculiarly fitted to make studies of labor turnover and its causes, efficiency of production and other studies that are undertaken by the efficient employment man.

Accident Prevention

It is stated that accident prevention consists of less than 10% mechanical guarding and more than 90% human element, but this less than 10% guarding calls for the best effort of the skilled engineer. One does not realize the ingenuity required to safeguard the hazard of moving machinery and other plant features until he has attempted to rectify the accident exposures that have been built into them by those with no conception of the safety program.

Not only are professional engineers used in accident prevention work by corporations with safety programs, but they almost exclusively compose the personnel of accident commissions, insurance companies and similar organizations, while those of the profession who have gone into consulting practice in this field are enjoy-

ing considerable success. The human element problem making up more than 90% of a safety program, the engineer who enters this activity must possess the same knowledge of it that is required by the engineer who specializes in employment work. Not only must he be familiar with the types of men performing various operations, but he must be equally familiar with the operations themselves so as to eliminate hazard from them.

Fire Prevention and Protection

Fire prevention is included under the things that go to make up human engineering for the same reason that accident prevention is put in this category, although the human element in preventing fires is not so great a consideration as it is in accident prevention.

Fire protection is wholly an engineering problem into which enters consideration of water supply, pumps, and the engines and motors by which they are driven. There are many problems in hydraulics and hydrostatics to confront the fire protection engineer, and when one is called upon to lay out an extensive automatic sprinkler installation, he finds that he must use many of the formula that he acquired during his engineering schooling.

Fire prevention engineering is largely a matter of structures and processes. Fire hazards are often built into structures and the engineer must devise means of their elimination later if he has not had the opportunity to eliminate them before construction was undertaken. Conveyors, dust collectors, spraying and dipping machines are a few of the more outstanding of the many thousands of fire hazards that are found in modern industrial operations, and the engineer is frequently called upon to exercise all the ingenuity that he possesses to devise less hazardous means of performing just as efficiently the hazardous operation.

In fire protection and prevention we again find the human element an important feature. The most prominent phase on the protection side is the organization and training of fire brigades. In fire prevention there is probably no more important feature than "good house keeping" which means nothing more nor less than cleanliness and orderliness. This is of course entirely a human element matter presenting the need for training men in good housekeeping methods which ordinarily do not come naturally to them, and orderly methods of procedure in the handling of materials in their raw and partially finished form and the finished product.

Conclusion

In the space available for this article it is impossible to present all the things that enter into human engineering, but the foregoing should be at least suggestive. It is surprising to find how large a part of the local engineering fraternity is engaged in this type of work. As before stated, many of these men are in the employ of large corporations, the insurance companies, state commissions and government bodies, while some few are engaged in consulting practice.

It is perhaps more important that the engineer, regardless of the activity in which he is engaged, should be in some degree familiar with human engineering than that there should be a limited group specializing in this field. Every engineer should be a safety and fire prevention engineer in that he should incorporate in every plan and in every specification upon which he is engaged the things that will assure accident and fire prevention. The greater extent to which the engineer in general practice acquires a sound knowledge of the principles of human engineering, the less need there will be for engineer specializing in this activity.

"I can fancy the emotions of Galileo when, first raising the newly constructed telescope to the heavens, he saw fulfilled the great prophecy of Copernicus, and beheld the planet Venus, crescent like the moon. It was such another moment as that when the immortal printers of Metz and Strasbourg received the first copy of the Bible into their hands—the work of their divine art; like that, when Columbus, through the gray dawn of the 12th of October, 1492, beheld the shores of San Salvador; like that when the law of gravitation first revealed itself to the intellect of Newton; like that when Franklin saw, by the stiffening fibres of the hempen cord of his kite, that he held the lightning within his grasp; like that when Leverrier received back from Berlin the tidings that the predicted planet was found."

—*Edward Everett.*

The Need of an Engineers' Registration Law

By GEORGE MATTIS
Past President '23
Consulting Engineer, Oakland

A registration act, licensing engineers to practice was passed in both houses of the last session of the State Legislature. The bill failed of law following a pocket veto by the State Executive. As an opportunity will again present itself a renewed interest should be taken by engineers in this much discussed question.

Here we are called upon to fix some rule and line for the future conduct of the Engineer, that which will give better stability, social prestige, deserved remuneration and a high code of ethics. For many reasons a code of perfect personal and technical conduct can never be made definite; but they may be carried on in the profession as entirely to fulfill the conditions to a more harmonious co-operation, especially in regard to their own society, their employers and the public.

Now just consider the status of the engineer in our state. In the first place he has no status, but consider him as he is. He gets up in the morning and buys his groceries from a licensed grocer; he rides to work in a licensed automobile driven by a licensed chauffeur or driver. He is shaved by a licensed barber in a licensed barber shop. He goes to his licensed office and takes up his unlicensed practice. He calls up his licensed lawyer; consults his licensed physician and calls on his licensed dentist. A licensed druggist fills his prescriptions and a licensed architect builds his home. His entire life is spent in the association of licensed professions, and businesses, but his profession is denied the dignity of a licensed status.

George Mattis

Just what does a license signify to a professional man? To me it is a certificate of competency. If the graduation, as an engineer, from a high grade certified technical University, and the certified actual experience of designing and directing the building of engineering works are not a guarantee of an engineer's fitness we had better close out the profession,—there are no engineers.

To what extent should such a law discriminate against the man who has been denied the opportunity of securing an engineering college training? The effect of the law should in no way prohibit him from becoming a licensed engineer, providing he has the energy and ambition to succeed by diligent study and is willing to progress according to his capacity and fitness to practice. But it should prohibit the competition of those who are without ability or merit and who attempt to gain practice by subservient methods which are not conducive to ethical regard.

The San Francisco, Sacramento and Los Angeles Sections of the Am. So. C. E. endorsed the bill, vetoed by the governor, as did all the chapters of the Am. Assoc. of Engineers in the State, and yet we have no law. The only reason we can ascribe to this state of affairs is the well-known fact of the lack of political acumen on the part of the large majority of engineers.

The opposition to the last bill in the San Francisco Section quoted at great length an opinion of their General Counsel in New York. Here again we have a glowing example of the impotency of engineers to rely upon their own knowledge and commonsense in a matter purely of engineering ethics. Why should engineers rely upon a legal opinion as to policies within their own profession? A lawyer may not be licensed in a strict sense, but if a lawyer displeases the Bar Association he is taken to strict account, and an engineer should also be held to strict accountability as to his actions.

At present our only guarantee against incompetency is the fact that the engineering profession is based on absolute facts. Two times two equals four and no amount of bluffing will avail an individual in an attempt to prove anything else. The design and construction of various kinds of works and structures must necessarily be at the hands of persons particularly qualified by reason of their experience, intelligence and character, in order that the successful building may be economic as well as physical. Furthermore it is not intended that such persons shall be required to compete in the importance of their work with those of lesser fitness and experience.

However, there are many times when engineers are confronted with practices in the profession needing regulation and that badly, in order to safeguard the property of the citizens. Almost any honest unbiased engineer knows of these conditions and should be only too willing to have the condition corrected.

It is time now for the engineers to again co-ordinate their efforts and have the law again brought up in the legislature. With the reiteration of previous arguments and proper presentation there should be no difficulty in again having the bill approved by the legislature.

But the engineers must not be content with that step. The governor and his aides must be convinced that the vast majority of engineers are in favor of such a law and that he will be held to accountability for its failure. This is where political influence was used against the bill heretofore, and if it again fails to secure the approval of the executive it will be the fault of its sponsors in the profession.

If proper interest is developed in behalf of such a proposed law with unity and co-operation by the profession, there is no reason as to why its ultimate success should not be assured.

G. Chester Brown,
Past President 1921

William H. Phelps
Past President 1922

The Future Water Supply of the Bay Region

By Charles H. Lee
Past President, '24
Consulting Hydraulic Engineer, San Francisco

The utilization of local sources of water supply in the San Francisco Bay region, which is now practically complete, and the rapid growth of the communities surrounding the Bay is turning the attention of thinking citizens to the future. The large cities have already taken steps to acquire distant sources of supply, and construction is advancing upon the two major projects, locally known as the Hetch Hetchy and Mokelumne, both of which involve bringing water from the Sierra. But what of the many smaller municipalities and the unincorporated areas, which, with the growth of the metropolitan district, will some day be demanding an adequate water supply for residential or industrial needs? Although possibly not realized as fully, these communities have a problem even more pressing than the larger centers of population. Many of them are growing more rapidly than the larger cities, and their local supplies are already fully utilized. In fact, there are many communities which depend entirely upon water pumped from wells which are drawing far in excess of the dependable yield, and have so lowered the underground water level that it stands far below the surface of the Bay. The supply of such communities may at any time become contaminated with salt water.

Charles H. Lee

The water problem of the Bay region is thus not confined to a few large cities, but involves all communities in the metropolitan area tributary to San Francisco Bay. The solution lies in a broad public understanding of the future requirements and the availability of sources, and also the early perfecting of local organizations to select, acquire and develop those sources necessary to meet the needs of the rapidly increasing population.

The position of San Francisco Bay on world-trade routes, its ideal conditions for residence and industry, and its central location with respect to the great agricultural valleys of California, insure its future as a great world population center such as New York or London. With modern transportation facilities, fifty miles from the population center may be considered as the limit of large metropolitan areas, although the future will undoubtedly see this limit exceeded. If a circle be drawn with the Ferry Building at San Francisco as a center, a fifty mile radius would include those portions of all the nine counties bordering San Francisco Bay which are inhabitable and topographically related to the Bay region. Although the total land area of these counties is 2,389,120 acres, the portions capable of intensive use, after excluding steep slopes and broken hill areas, amounts to 876,300 acres. This is the area which ultimately will be thickly populated and must be supplied with water. It is slightly greater than the area included within the present Metropolitan District of New York.

Various estimates of the future population of the Bay Region have been made. The writer's conclusion, which differs but little from others which have previously been made, is that between 5,000,000 and 6,000,000 people will ultimately occupy the inhabitable portions of the nine Bay Counties. This is equivalent to an average density of 6.5 persons per acre on the area of 876,300 acres. The present density of population in the New York Metropolitan District is 10 per acre, and in Greater London 17 per acre. Climatic conditions and improved transportation facilities will probably always be effective in maintaining a lower population density than in these older communiies.

The determination of the future water requirement of a metropolitan district is not as

simple as in the case of a single community. The usual method based upon estimated population and probable per capita water consumption, although satisfactory for periods of a few years, and for one community supplied from a single system, does not give reliable results when the varied demands of a metropolitan area are involved. In such areas great quantities of water are used for other than domestic purposes. The demands of industry and agriculture are large, and the use of water for the beautification of grounds surrounding suburban residences, and in parks and golf courses, also assumes importance. The most logical as practical basis for computation of these varied requirements is probably the equivalent depth of water used over the service area during a specified period of time. The use of water in irrigation is customarily expressed in this manner, and with acreage data for the service areas of water works systems for which the total consumption figures are available, the depth can be computed for general use in various types of communities. Industrial uses can also be expressed in this manner. Considerable data of this character is available to the writer, and he has recently had opportunity to apply it in detail to the various portions of the future Bay metropolitan area, taking into consideration the probable use within each unit of area and the density of population. The results of this study indicate that there will be an ultimate demand of nearly 1100 million gallons of water per day in the nine Bay Counties.

The amount of water now developed from local sources for the supply of communities in this area is approximately 100 million gallons per day. The construction of additional storage reservoirs as additions to existing systems, the most important of which have recently been completed, will materially add to this total. Adding this to a possible full development of Santa Clara Valley streams for local use, there might ultimately be developed from local sources 250 million gallons daily. The difference between this supply and the ultimate demand, amounting to 850 million gallons daily, must be furnished from distant sources. The Hetch Hetchy, Mokelumne and Eel River sources, if brought to the Bay region in the amount now proposed, would supply a large part of the deficit. Still another source, however, such as the winter flow of the Sacramento or San Joaquin River may ultimately be necessary.

It thus appears, when looking at the problem broadly, that we should not now be concerned so much with which source to choose, but rather how best to secure all the sources that will ultimately be needed. The question may arise, why should this generation concern itself about the problems of the next? The answer is simple; California is largely semi-arid in climate and water is everywhere essential to growth. If one community or industry does not use water which now goes to waste, another will do so. The definite initiation of a project gives notice of future intention, and may obviate costly purchase or condemnation of communities and industries which have not yet been built or even planned.

The long transmission systems necessary to bring water to the Bay Region from distant sources constitute a hazard, especially in a region subject to earthquakes. This hazard can be largely overcome, however, if ample storage is provided near the various communities receiving water. Fortunately, past history shows that earthquakes have independent origin on opposite sides of the Bay, and major shocks have never been known to occur simultaneously at different points on the Bay region. It is therefore improbable that damage to a water system serving one side of the Bay would occur when systems serving the other were out of commission. The value of local storage combined with as complete interconnection of systems as possible is thus apparent. It does not trespass upon the realm of imagination to picture the utilization of all available reservoir sites in the Bay Region for storage, with an interconnecting system of pipe lines and conduits which would permit of feeding into any distribution system at times of emergency. In this manner the total volume of local storage might be greatly increased as well as the diversity of sources.

The establishment of such a super-water system for the Bay Region involves difficult physical as well as financial and political problems. The cost of interconnecting pipe lines and of reserve storage reservoirs will be great, and the distribution of the cost among the various communities would be a task of considerable magnitude. The thickly populated areas are already organized for handling water enterprises, either as municipalities, water districts, or public utility districts, but there is much adjacent territory which would benefit, for which there is no legal means for taxation or representation. The North Bay region, the Peninsula and the Santa Clara Valley are all in this condition. The first step toward comprehensive handling of the water problem of the future metropolitan area is the provision of the necessary legal organization.

The form which such organization should take has been the subject of much thought and effort in the past. The present trend is toward local ownership and operation of water systems

either by municipalities or districts. This plan in conjunction with a super-district to function in unorganized areas or on matters of common interest, such as reserve storage and interconnection, would seem to be a practical working out. A source of possible difficulty under such a plan might be the disposal of surplus water by units which had acquired a supply larger than the area within their existing political boundary would ever require. Doubtless such a situation could be handled, however, by the organization of small districts which would contract to purchase water wholesale, or a large district to include the original political unit and the adjacent territory requiring water, such large district to take over the sources of supply and transmission system. Under the latter plan a supply might be brought in for areas urgently in need of water, more rapidly than contemplated by the original political unit.

Whatever form of organization is adopted in the Bay region, much time will be necessary for preliminary discussion, and no time should be lost in placing the matter before the public in a concrete form.

A Present Day Aqueduct. The Building of Like Structures for the Safe and Adequate Transmission of Water is Usually Justified by Resulting Public Benefits.

The Future of Electrical Development In California

By Louis F. Leurey, *Past President, '24*
Consulting Electrical Engineer, San Francisco

To better understand the future of electrical development in California it is necessary to briefly survey the history of its progress from earlier stage to the present development which gridirons the state.

Historical

California cities, and notably San Francisco, were among the early users of commercial electricity. The history of the present public utilities of San Francisco began in the year 1880. In common with conditions that obtained in other parts of the country, this first development took the form of direct current street lighting with small steam driven power plants used as a source of energy.

Progress was very rapid at first, and soon the new form of lighting was being used in the lighting of commercial buildings and in the operation of electric motors. Not only did utilization proceed by leaps and bounds, but technical systems and equipment were changing with extreme rapidity. About the year 1900 the complete advantages of the alternating current system were fully realized, and from that time on alternating current distribution has dominated the electrical field, but large quantities of direct current are still in service in most of the downtown areas of the average American city.

The rapid growth of electrical utilization very soon outgrew the earlier steam plants, and it became increasingly difficult and expensive, with the slow speed engines of that day, to keep the generating plants abreast of their electrical demands. Attention was thus fixed on the possibility of developing water powers and transmitting them to centers of usage, and here California took the lead over practically all the states in the Union in the development of these earlier water powers and the consequent development of the first high voltage transmission.

By the year 1906 the alternating current transmission over distances of 100 to 150 miles was firmly established at 60,000 volts, and about this time designs were being made for transmission at 110,000 volts in order to increase the range and promote the economy of available water powers. By 1910 the 110,000 volt transmission was firmly established, but brought with it a number of intricate engineering problems not before realized, notably the corona loss and insulation difficulty with long strings of suspension insulators.

By 1919 these problems had been fairly well worked out and 110,000 volt operation was safely established. In the meantime density of loads had been increasing on a steadily compounding rate, and the utility engineers realized that if the load requirements for the future were to be met, higher voltages must be developed in order to bring in more distant sources of electric energy and to more economically transmit the continually enlarging blocks of power which must travel over these lines. Close co-ordination during this period between the manufacturers of electrical apparatus, the research laboratories of the Unversities and intensive study by the utility engineers resulted in the development of the 220,000 volt system of today, which can successfully transmit over a single circuit, blocks of power as large as 150,000 horsepower for distances of 200 miles and over. The ability to transmit such large blocks of power successfully has made available distant hydro-electric sources hitherto considered inaccessible, and has made possible the exchange of large quantities of energy between utility systems located several hundred miles apart.

Future Development

To meet the ever increasing density of electrical usage it will be more and more necessary in the future to carry out a diversified and thoroughly interconnected development of all hydro-electric resources in the State of California. The tools at hand in the way of high voltage transmission, automatic station control and interconnected networks, are now making available, both physically and economically, a number of minor power resources which would otherwise have no advantages for development as independent institutions.

By-Product Plants

California has again taken the lead in a new phase of electrical development by virtue of the number of by-product plants which have been installed, or are in process of being installed, by Irrigation Districts in this State.

The Modesto and Turlock Irrigation Districts put into service the first development of this type at their Don Pedro storage reservoir, by which the impounded water for irrigation is passed through water-wheels driving generators on its way to the irrigation canals, and a large and important source of electrical power developed. These districts are utilizing this power for distribution within their own boundaries, and today one of them is selling its excess power to the San Joaquin Light and Power Company.

The Merced Irrigation District has built another important plant at the Exchequer Dam, and has contracted to sell its output to the San Joaquin Light and Power Company.

The South San Joaquin and Oakdale Irrigation Districts have developed a third important source of power in their Melones Dam, but instead of generating the electrical energy themselves, they have sold the use of the water to the Pacific Gas & Electric Company to be utilized in generating electricity by passing through a new power house built below the dam.

The last plan is the most thoroughly considered of them all, because it gives the irrigation district the full financial benefit of its electrical by-product without diverting any capital from their primary business; and it has a still further and most important advantage in not diverting the attention of the irrigation directors from their primary problem of successfully raising crops on irrigated land. Undoubtedly this type of by-product plant will be built from time to time in California, and, if guided by sane considerations, will blend in most economically with high head and distant generations of power tied together on a common network.

Base Load Plants

From an engineering point of view the theory has always been held in California, and practice has proven it, that base loads should be carried on Hydro Electric Plants, thus taking advantage of the absence of fuel costs, and by high load factor largely counteract the high capital costs of the Hydro Electric System. On the other hand, Steam Electric Plants located in important centers, due to their lower first cost and relatively higher fuel costs, are used primarily for stand-by and insurance service, as well as for regulation at the end of long transmission.

Several acutely dry years in this State have recently focused sharp attention on another function of Steam Electric Plants, namely to meet the problem of kilowatt hour production in these dry years in contradistinction to their usual function of insurance and regulation. On account of low costs of fuel due to liberal supplies of natural gas, one large Southern California Utility Company is now developing its steam plants for base load operation, and another Southern California Utility Company generates its entire output from steam. Regardless of this local situation, the general situation in the State remains unchanged, and California will in the future undoubtedly look to hydro-electric resources for the supplying of base load requirements. Even Southern California is not excepted from this condition, as is evident by their interest in the development and transmission of energy from the Colorado River to Southern California. However, with the increasing duty imposed on interconnected network in all parts of California, and the increasing necessity for an ever higher standard of service delivery, conditions will undoubtedly modify the ratio of steam to hydro-electric delivery of kilowatt hours and will result without question in an increasing average of such energy developed from steam.

Load Density and Interconnections

The constantly increasing development of new uses for electrical energy and the intensified use of existing facilities is creating a problem which the Utility Companies will only be able to meet in proportion to the active interconnection which they successfully establish within their own and neighboring systems. This establishing of interconnections is not a simple engineering problem, but brings with it a whole train of operating difficulties due to the enlarged network which will call for a most exhaustive study by utility engineers, manufacturers, and the great University laboratories that are established on this coast. Regardless of the policy adopted by a number of municipalities, the day has definitely passed when any single source of power can be successfully tied to any individual municipal distribution system unless it be a fact, and recognized as such, that the municipality in question has reached a definite limit of growth and will no longer be a factor in the general progress that is apparent on every hand in Pacific Coast development.

Whether economic necessity for interconnections will further reduce the number of operating companies or not is a question which only time can answer, but regardless of financial or management combinations, the physical interconnections of these systems must progressively increase or they will never be able to render to the Pacific Coast area that service which is necessary for its growth and development.

Additional Water Supply for East Bay

By Arthur P. Davis, *Member*
General Manager, East Bay Municipal Utility District

The nine cities on the eastern shore of San Francisco Bay have for years been receiving water supply in the main from the East Bay Water Company. This supply is obtained mostly from wells, but is supplemented by reservoirs on San Leandro and San Pablo Creeks. The experience of the last few years has shown the supply to be inadequate and precarious. The wells from which the greater portion of the supply is obtained have been pumped far beyond their safe capacity for several years, and the water table in their vicinity has been lowered in that period an average of about 30 feet. A serious water shortage occurred in 1918, and has been threatening at intervals ever since that date but narrowly escaped. The service is also entirely inadequate, as shown by its failure to adequately cope with the great Berkeley fire in 1923.

Arthur P. Davis

For many years the thoughtful men of the District have been of the opinion, entertained by most other growing municipalities, that the water supply can be successfully handled best by a public organization, and to this end, in 1923 a municipal utility district was formed to secure a large additional water supply for the present and future needs of the inhabitants of the cities of Oakland, Berkeley, Alameda, Richmond, San Leandro, Piedmont, Emeryville, Albany and El Cerrito. Richmond and El Cerrito are in Contra Costa County; the other cities are in Alameda County.

Under the state laws, it was impossible to obtain funds from taxation until July 1, 1924, and only preliminary work could be accomplished before that date, but at that time a large force was placed in the field to carry out the work planned. An examination of available sources of supply led to the selection of the Mokelumne River as being the nearest, and cheapest source of water which is adequate in quantity and of satisfactory quality.

The project involves the construction of a high dam on Mokelumne River about four miles north of Valley Springs, and pressure pipe and tunnels to convey this water to the district. The entire main aqueduct will have a length of about 93 miles, of which about 9 miles is in tunnel, about 3½ miles is reinforced concrete aqueduct 9 feet in diameter, and the balance is steel pressure pipe ranging from 61 to 65 inches in diameter. The portion of the aqueduct west of Old River, a branch of the San Joaquin, is being constructed as an emergency measure under contracts requiring its completion within eighteen months of signature. This period expires in April, 1927. It is the plan to hold this aqueduct in readiness to pump water temporarily from the San Joaquin River to San Pablo Creek, whence it will run into San Pablo Reservoir. This is a temporary emergency measure, designed to obviate water shortage, if this becomes necessary before the completion of the aqueduct from the Mokelumne River.

Contracts for the Lancha Plana Dam and the portion of the aqueduct leading from that reservoir to Old River were entered into with the proviso that activity thereon be deferred until necessary rights of way are secured, including the license from the Federal Power Commission for the use of public land. This license was issued June 23, and cleared the way for the purchase of additional rights of way, the acquisition of which is now in progress. These deferred contracts provide for the completion of the aqueduct and of the dam of a height sufficient to divert water into the aqueduct within thirty months from the date of the order given to proceed with the construction work.

The Walnut Creek Tunnel, having a length of one-half mile, has been completed, and the Lafayette Tunnel, nearly three miles in length, has the excavation about 90 per cent completed, and some work has been done on

the lining of this tunnel. The concrete aqueduct connecting these tunnels is more than half completed.

When tenders were received for the construction of the steel pipe line, it was found that a saving of nearly $4,000,000 could be made by employing the electric arc welding process for the pressure pipe. After careful consideration, the contract was awarded to Twohy Bros. Company for the construction of electrically welded pressure pipe.

This method of manufacturing pipe of this weight and diameter was in an experimental stage, and so recognized, but by persistent and careful effort in improving the appliances, methods and workmanship on this pipe, good results have been obtained and good progress is being made in its construction.

About sixteen miles of this pressure pipe have been placed in the ground and five miles more have been delivered along the right of way ready for placing.

The present prospects are that the portion of the aqueduct between Old River and San Pablo Creek will be completed on scheduled time, or about April, 1927; and that an adequate water supply from the Mokelumne River can be delivered some time in the year 1929 and the reservoir completed soon thereafter.

Cover Design

By E. E. Westergreen

The original of the design which is reproduced on the cover page is the work of Jo Mora, nationally known sculptor, and accepted by the Mt. Diablo State Park Commission as the final design of the proposed monument to stand on the summit of Mt. Diablo.

The design is not only interesting from an artistic standpoint, but remarkably comprehensive in its conception. Its theme embraces the legendary and traditional histories of the noted Contra Costa landmark. With these the artist has linked the practical use which the mountain serves today as the key to all of Northern California's surveys.

The general character of the rendition of its details is reminiscent of American Indian art. The completed monument will consist of a tripod and a central pedestal supporting a cap which takes the form of a solid bowl.

Three grotesque figures comprise the details of the pedestal, namely, the Indian's sun god, devil and bear. These also typify various legends of the mountain, the bear recalling Bret Harte's fascinating "The Legend of El Monte Diablo."

On the three legs of the tripod, which take the form of upright panels, are bas-reliefs emblematic of three periods of California's history, the Christianizing period of the Spanish Padres, the American pioneer and that of the establishment of law and order as represented by the civil engineer. The latter also records the establishment of the Mount Diablo meridian and base lines which are the basis of all surveys in this part of the state. Three friezes embellish the sides of the cap of the monument and occupy spaces between the points of support of the tripod panels. These friezes are Indian interpretations of the three periods represented on the panels.

Embellished with radiating arrows the cap on the completed monument will fulfill the principal purpose of the indicator as these arrows will point the direction in which lay the major points of interest in Northern California which are visible from the 4,000-foot summit of Mount Diablo. The cap will also carry suitable inscriptions regarding the erection of the monument. It is to be made entirely of granite, the cap being polished on top. When completed it will weigh approximately four tons.

For the purpose of reference and scientific observations, the monument is designed to meet certain conditions imposed by the cadastral engineers of the Department of the Interior. Convenience and ease of access to the initial point must be maintained. The setting of the monument will be established by mathematical precision, its initial point taking the place of the present one and occupying its exact position.

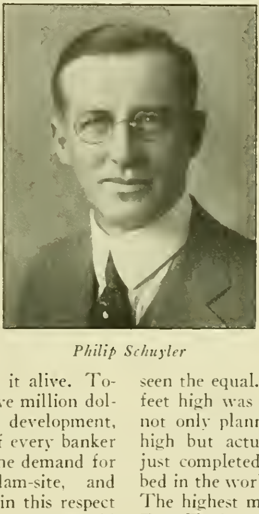
The Engineer and the Far West, Yesterday, Today, and Tomorrow

By PHILIP SCHUYLER, *Member*
Editor, Western Construction News

The "birth of a nation" dates from the time it starts on the path to world-wide recognition. Therefore, California and the Far West is hut 75 years old, or more truthfully speaking, young, for mature and mighty as we may think ourselves, in the eyes of the men of vision we are only in our infancy.

During the first 50 years the Far West developed mining and railroad engineers of world renown. In engineering construction we have forged ahead by leaps and bounds during the past ten years, taking the lead in many different lines. But what we have done in the last decade is nothing to what will be accomplished during the next ten or twenty years.

Let us review a few of the recent outstanding engineering achievements of the Far West and thus try to visualize what lies before us.



Philip Schuyler

Twenty years ago the hydro-electric industry was a babe in arms, and in this the Far West pioneered; in the development of high-head impulse water wheels, long-distance transmission lines, and high voltages. Even as recently as ten years ago this industry was still a mere infant fighting for its existence, begging at the banker's door for sufficient funds to keep it alive. To-day, we are expending seventy-five million dollars annually on hydro-electric development, taxing the combined resources of every banker and capitalist to keep ahead of the demand for power. Every water-right, dam-site, and power-site is at a premium, and in this respect we may assume that any financial center would gladly accept their control.

California has the distinction of having the five highest head hydro-electric plants in the world, three recently completed and two under construction. The longest and highest voltage transmission lines are in the West, including the longest channel-crossing spans. Recently the largest transformers ever built have been installed in California substations; and now the General Electric Company is huilding for Southern California Edison Company, the largest steam turbine-generators ever designed, thus heralding the beginning of a big development on the Pacific Coast in steam-generation of electricity. At Stanford University, Professor Harris J. Ryan has a new especially designed and equipped laboratory for experimenting with 2,000,000 volts, the highest voltage ever attempted.

Some of the largest and deepest oil fields in the world are in the Far West, the development of which has taxed the ingenuity of Western engineers, in the design of deep-well drills and enormous storage reservoirs. That more fields of even greater depth will be developed is a certainty.

In irrigation—an engineering achievement of the ancients all over the world—we have not only kept abreast of other countries but we have taken the lead. Most of the big U. S. reclamation projects are in the Far West. The Sweetwater dam, near San Diego, was the pioneer in big dams for irrigation, and for twenty years was an outstanding achievement. Then began a program of dam construction, the like of which the world has never seen the equal. Ten years ago a dam over 300 feet high was a wild dream. To-day, we are not only planning dams of 400 and 500 feet high but actually building them. We have just completed the highest dam above stream-bed in the world, the Exchequer, 324 feet high. The highest multiple-arch dam ever built, the Frog Tanks, is being constructed near Phoenix, Arizona. The Pacoima dam under construction for the Los Angeles Flood Control will be 375 feet above stream-bed and the proposed Two Forks site dam in the San Gabriel River canyon for the same purpose will be nearly 500 feet high, and will contain 4,000,000 cubic yards of concrete, the estimated cost being $25,000,000. There are about fourteen dams in this $60,000,000 program of flood control, several being under construction. In

the Northwest, the City of Seattle will construct two dams on the Skagit river for hydroelectric development, the Diablo dam 365 feet high and the Ruby dam 520 feet high above stream-bed. Everyone knows of the proposed Colorado River development, which will involve the construction of many dams for flood control, irrigation, water supply, and hydroelectric development; the largest of which will probably be the Boulder dam, 550 feet high; costing over $70,000,000. Hydraulic-fill dam construction is distinctly a product of the Far West, the San Pablo, Big Meadows, and Upper San Leandro, being notable examples.

In Municipal water-upply development, the Hetch Hetchy, Mokelumne, and Owens Valley projects, and the Spring Valley are unequaled; nevertheless, soon to be outclassed by the Colorado River supply for the city of Los Angeles.

In the regulation of stream-flow, more equal distribution of run-off, and saline control, the problem of the San Joaquin and Sacramento valleys, California is not only a tremendous engineering undertaking, but a unique one.

In harbor development, marsh-land reclamation, and bridge construction, we have barely made a beginning; and yet, the making of one of the largest harbors in the world, in point of tonnage, out of practically nothing in just a few years' time, is an engineering achievement Los Angeles and the West can feel justly proud of. The Alameda Estuary Tube, from Oakland to Alameda on San Francisco bay, predicates a revolution in subaqueous subway construction. In fact this is not only the largest tube in diameter but the most daring piece of engineering design and construction ever attempted. The Carquinez Strait bridge on San Francisco bay is one of the world's five largest bridges, the pier foundations for which were extremely deep and difficult to build. There will be more large bridges constructed, and soon. The proposed Golden Gate bridge, on San Francisco bay, is so much bigger than any other bridge ever built or contemplated that a comparison is impossible.

In high way construction we took the lead and still maintain it with a contemplated program entailing the expenditure of 300 or 400 million dollars.

In building construction the Far West has held its own—many of our recent skyscrapers and public buildings being the equal in size, completeness, and architectural beauty of any in the East or Europe.

Although we have several up-to-date plants for the treatment of sewage and industrial wastes, physical and climatic conditions in the Far West necessitate our pioneering in this branch of engineering, for as yet we know little or nothing about this important subject.

Water purification — filtration, color removal, softening—is sweeping westward, and the time is fast approaching when every surface-water supply will be filtered and every hard water softened.

And last, but not least, we come to industrial development, which is just beginning, but the magnitude of which during the next ten or twenty years will exceed anything ever done anywhere in the world.

In the superintendence and management, as well as the design and construction of industrial plants, the engineer has a wonderful opportunity.

This is the day of the engineer, the greatest opportunity the world has ever offered. Not for the narrow seriously engrossed technical student, but for the engineer with a thorough technical training and apprenticeship with the ability to visualize and analyze a problem quickly; one who can express himself clearly and concisely, orally as well as in writing: the man who keeps in touch with the banker and industrial leader, and takes an active interest in all social, civic, and economic affairs.

As the late Professor Merriam so tersely stated, "Modern Engineering is the art of economic construction," and as Dexter S. Kimball, Dean of the College of Mechanical Engineering, Cornell University, and President of the American Engineering Council, more recently emphasized "the field of the engineer of tomorrow is in economics."

A Message

The obligations of citizenship do not rest solely or chiefly in the exercise of the privilege of voting, or in conducting campaigns, or in holding offices. Important as are all these duties, their performance will amount to nothing unless our citizens are imbued with the spirit of our institutions, which means respect for a government of law, a sincere desire to better in every practical way the conditions of human life, loyalty in all relations of life, and the disposition to be kindly and fair in all dealings with one's fellow men.—Charles E. Hughes.

City Re-planning

By George E. Tonney
Vice-President

It has been suggested, opinioned in the belief, that certain physical developments in the past decade have become so impressive that proposals having to do with the city plan should be nation-wide rather than the concern of a few of the large cities; also, that the local problems of utility and accessibility, from the viewpoint of carrying into effect any predicated plans designed to affect and serve efficiently an entire community, have received less recognition by the public than any important problem affecting American social and industrial welfare. The advent of automobile vehicular traffic, and the desire to generalize and extend the products of public service utilities occasioned by economic factors, are the foremost causes which we may attribute to the need of every growing city and community to devise serviceable schemes which will tend to expand the field of beneficial activity. It is true, we are revising and enlarging our public conveniences as necessity makes the demand, but the majority of the projects we build are not a direct portion of any greatly coordinated plan.

George E. Tonney

City re-planning, used figuratively, is the expression here preferred, for indeed it would be improbable to find a city actually built according to a definite plan. The average American city has been built without consideration, or at least seemingly so, with regard to certain phases of a future period. No reproach can be given to the builders for lack of vision or preparation, their cities having answered such purposes as were found necessary to carry on mutual relations. But just as we inherit, so must we expect to utilize our physical structures in a relative degree, especially where such establishments prevail in the order of permanency.

It is well to reflect with an expression of admiration and gratitude for those who have devoted their life work in the interest of city plan development. No single group of men have received less support, much less credit, many times their projected schemes suffering reversals to the extent of precluding the objective, or complete abandonment through lack of public appreciation or foresight of their necessity. Fortunately we now have in the field organizations alive to conditions and well calculated by a progressive and patriotic spirit, that are contributing their effort to the investigation and promotion of problems component of city and community welfare. It is certain that the foundation of a diligent movement is laid. But not until the time when concerted realization of benefits that can be derived from comprehensive planning prevails with the public can any tangible results be expected.

The problem of vehicular traffic perhaps requires more immediate attention than any of the important factors entering into the city plan. But even with all its complications, in the midst of a multitude of attempts containing too many unknown variables to allow of a solution, the major traffic problem is not one surmounted by great engineering difficulties; at last, after all the abstractions of philosophy, the simplest and plainest things are the most effectual and there is little to consider other than to create traffic arteries, so chosen for their convenience, and their lines adjusted to such a width as will be adequate. Just as the City of Paris, yielding to necessity, has seen fit to create boulevards through property accession, so must we expect to meet emergencies imposed upon us to be solved by street widening, tunnels, subways or overhead structures as the case may be, and these are to become in time not distant the concern of every city. We may safely conclude that highway construction is being consummated as rapidly as can reasonably be expected. If highway systems are able to keep apace with the growth of traffic, intertraffic without serious interruption can be

maintained only through the ability of cities to provide facilities which will properly and effectively insure traffic transmission. This is especially true of cities in close proximity to each other.

As an incident to the remarkable growth of vehicular traffic and its complexity, every city in America is faced with the problem of reconstructing streets, the original over which they have exercised no control. The conventional systems of plotting and developing new additions or subdivisions in their entirety represent the views of their respective developers who are not restrained in action by any particular law or body charged with authority to pass upon the feasibility of their proposals. As a consequence inconveniences and hazards, even to the extent of isolating large areas, are often the result of such planning which ignores the salient features of a plan requisite to progress. We are reminded of a condition existing in one of our large cities where the accumulation of additions, evidenced by irregularities, has caused a thickly populated area of 40,000 people to become seriously handicapped for lack of the facilities necessary to their egress. Until proper control can be exercised over new extensions we may conclude that a most essential principle of the city plan is being violated, imposing local conditions which may impede the progress of tomorrow.

Industrial and residential zonings are vital factors of a comprehensive plan. Districts so designated establish the character of future establishments and institutions. A good zoned district so chosen for suitableness or adaptability carries such assurance and is defined for the benefit of an intended purpose. Restricted residential districts form of zoning has proven popular for the reason that it confirms and stabilizes property values, affording holders relief from the encroachment of uncertain elements.

Industries so districted are placed in a position of advantage particularly in regard to water, railroad and air service shipping facilities. Railroads rightfully given the opportunity of extending their tracks into specified areas serve as an inducement to influence prospective industries to decide on location. Territorial latitude extended to railroads assists in planning terminals in regard to future development of an industrial zone.

Suburban municipalities have become so numerous, and their growth so rapid, that they collectively present by their appearance a continuous city. Adjacent, or not separated by great distances, each is striving to achieve some particular objective characteried by location and other features offered as an inducement to increase the scope of its industrial and financial operations. This situation is of special significance, suggesting only the possible conclusion that industrial development, economy of manufacture, stabilization of property values, intertransportation and civic welfare must be studied and treated as a whole rather than as competing and conflicting units. It is with the larger conception of economy in mind that we look to further development, and in this respect that every prosperous city will eventually adopt a regional plan.

The regional plan presents a broader and more inclusive program designed to include all of the cardinal features as incorporated into a city plan, and as such it may be considered merely as an extension to include such surrounding territory which constitutes a metropolitan area. The idea is not actuated by spiritual adventure or selfish purpose, but by the medium of sheer necessity whereby traffic arteries and avenues of communication can be opened which will be direct and adequate, all forms and methods of passenger, freight and energy inter-transportation established, and water, power, gas and sewers sufficiently provided to meet the increasing demands, and bring about more satisfactory relations among the various municipalities. These fundamental factors cannot be intelligent and equitably considered without reference to problems arising from the necessity for the conservation of resources, materials and energy. Increasing the source of supply in the light of modern engineering capable of mass production—the product distributed efficiently and serving the greatest number of consumers at the least fraction of loss and expense—accomplishing a common purpose through the medium of a centralized or unit production rather than through the processes of duplication, is the condition exacted to further the cause of conservation, one of the most vital problems of the present and future.

Scientific management, or efficiency in the operation of an industrial establishment is not necessarily a measure of economy; but where waste can be eliminated through the agency of improved methods of production, economy is assured. Competition in the future is bound to become more pronounced than ever before in history, especially in international exchange. Any methods designed to reward a producer in his effort to meet such exigencies must lie within his success to control, or utilize economic waste. However, the salutary solution of the problems of economy as demanded by the world at large must extend far beyond the individual producer and in the extent of effecting entire industrial centers, carried out

on a scale of extended magnitude, whereby those sharing in common may profit and benefit. It is intended that such factors of economy be derived as a product of the regional plan.

A regional plan can be made possible only through the passage of certain laws authorizing cities to create improvement benefit districts, and such a program touching every phase of life, every vocation, every recreation, and every industry cannot be accomplished in a day or a year. It requires the contribution of constructive and whole-hearted support concentrated in its effort. Prompted by legislative enactment paving the way, economy determining the relative of practicability, and engineering to insure proper structures, are the circumstances requisite to fulfill conditions by which large populated areas can proceed to develop their natural advantages and establish and enjoy proper relations to the concern and benefit of the region in its entirety.

Responsibility of Engineers in Modern Civilization

In celebrating the birthdays of Washington and of Lincoln the engineer honors, not alone the patriots and the statesmen, but also men who were for a period of their lives engineers, as the term might be used during their respective times. George Washington was public surveyor for 3 years and Abraham Lincoln, deputy to the county surveyor.

The public has looked to the doctor, the lawyer, and the teacher with a certain blind confidence, based on the belief that men in these callings are qualified to successfully perform the duties entrusted to them. This confidence is theirs because of the title—professional men—that is their right of supervised training, and because of legislative approval of their qualifications. Lawmakers have felt that the public welfare can only be safeguarded by making certain that these men possess certain qualifications.

One who consults these men may chance his his life, his property or the welfare of his children on the accuracy of their knowledge and the purity of their motives. In our age of industrial expansion and social concentration, the engineer is assuming, and has to a great extent assumed, a great part of the responsibilities of these men. He safeguards health by supplying pure water, and by removing sewage and other wastes, rendering them harmless. He safeguards property and life by improving conditions in dangerous industries, by protecting communities from the ravages of fire and water, and by devising numberless inventions for the improvement of transportation and manufacture. He safeguards future generations by improving methods of production, and making possible greater periods of leisure for the majority of mankind.

His profession is new, for the last century has seen the application of more scientific truths than had all preceding time. In early times the engineer was to a great extent a soldier, and his work was at fortifications and harbors. The development of the steam engine, of surveying, and of the great surveying systems in the early part of the last century caused engineers to specialize in these fields, as civil engineers.

Rapid strides made by the profession, and the pioneer nature of the engineer's work, lent a certain glamor of romance to his title, and it has been improperly used by draftsmen, surveyors, mechanics and even laborers, of the present day. The enineer has never, through legislative action, been able to curb this improper use of his title, because of the individual and independent nature of his work. Public confidence in the professional status, and even in the personal ability of the enineer has been shaken by this issue. His training, and the nature of his life's work, further tends to rob him of the opportunity to acquire the public position and the remuneration which his supremely important duties merit.

This condition, in other professions, was remedied by the associated action of its members. The earlier engineering societies, composed largely of successful men with established practices, confined their efforts to the increase of professional knowledge, and to the ethics of their own select group.

As its engineering influence grows, we confidently look, at an early time, to a marked decrease in the drain in life and money caused by flimsy and incompetent execution of enineering work. Countless failures of bridges, buildings, dams, and machines could have been prevented had its ideals been universally accepted and observed.

—*V. Bernard Siems.*

Side Lights on the Society Service Bureau

By ALBERT J. CAPRON
Secretary

Herbert Hoover has given considerable consideration and thought to the conservation of labor and in co-operating with many industrial organizations, and by his effort there has been brought about a substantial saving in man power.

To assist in this movement it was our belief that we would be justified and could obtain the desired results through the establishment of an employment service bureau for engineers, this was accomplished several years ago and during the time of its activity has proven itself to be of an unusual benefit to the organization. It was in connection with the operation of this office and in the placement of skilled men to positions that we found it necessary to incorporate an educational feature and in this instance the end has sustained the means, the results obtained having achieved a measure of success even greater than our hopes had anticipted.

A. J. Capron

It is said, and perhaps justly, that the engineer while among the best educated of all scientific men, is the poorest salesman of his ability. We know from experience that many an able engineer has failed of success simply because he did not know the best method of approach when it came to selling his service to a potential employer.

In the curriculum of the engineering college there is no course of instruction tending to give the student practical knowledge in the art of salesmanship so requisite to his future success. This office long since realizing the need of an educational by-product of this nature has developed what might be termed a "school of instruction," whereby these men might learn or at least become acquainted with certain ethics necessary to the important part of individual propriety, and in teaching this we have given our best for the benefit of the profession.

While it is the young graduate who mostly needs instruction, yet many times we find the older one as lacking as his younger and less experienced brother engineer. The young man too, needs vision as he does not always appreciate the fact that this important factor often makes him a valuable asset to his employer. He is very much inclined to imagine that a diploma should be the sufficient recommendation for an executive position, giving little regard or thought to the fact that an education without actual practice is of little value to the employer. It is well to be ambitious for without this trait of character one's future is dark and uninviting, but this particular kind of an ambition usually spells failure for the applicant and he quickly becomes dissatisfied, attributing his cause of failure to the profession rather than to himself. The ancient Greeks had a proverb "know thyself," and until a young man knows himself he is not in a position to know other men, both essential along the royal road to success if there is such a highway. Our most difficult field of service is helping the young man first of all to be able to analyze his own weakness, then to know his employer whom he must study with the same amount of attention he gave to his books in college and until he knows him as well as the work in which he is engaged he cannot expect to achieve any great measure of success. There is nothing strange or uncertain in such a requirement for it must be remembered that "The engineer must learn to apply his training to every field of human activity."

Lack of attention to one's personal appearance often causes the loss of the objective. Unclean hands and soiled clothes are all stumbling

blocks to success. If one is careless with his person he may be equally careless with his work. The man who fails to value his emplayer's time confidentially placed within his care violates one of the most essential laws in the ladder of success. "Render unto Caesar things that belong to Caesar" and to give the best of one's ability to the interest and concern of service is always to be commended and many times I have heard an employer state referring to such a young man, "He is neat, orderly, prompt in reporting for work and upon leaving places his work in good condition ready for another day to come." Our greatest men are among those who "saw it through" and whose vision enabled them to take a personal pride in their work rather than having the mere thought of securing dollars and cents.

And just a word regarding savings, for the rainy day or for the day when they would enter business for themselves. It should be the goal of every ambitious engineer to start and maintain a savings account, even though they may be able to contribute only a small portion of their salary to such a fund. A careful man would protect himself against the unfavorable day of unemployment, accident or sickness. There is another angle to the wisdom of such a movement. The average employer believes, and justly so, that the man who saves his money is also considerate in the saving of his employer's time. The pitiful thing in our experience is the man who has passed the middle life and is looking for work. He has passed the dead line of forty-five years. True his experience is valuable; but in the scheme of the larger corporations, there is no place for him because their plan of retirement does not enable the man to supply his share of the necessary earning power during the time before retirement.

To sum up these few side lights it should be the object of the engineer, to be honest with himself and towards his employer, neat in appearance and active with his work, avoid gossip, study the employer, and "render unto Caesar things that belong to Caesar." Do a little more than called upon to do, make yourself so valuable by your work that your employer will list you as a prospective "higher up." Work consistently in the interest of the firm that extends to you employment and remember that "Society in every field is more and more in the need of the services of the engineer."

It is the aim of the Society service bureau to efficiently distribute engineering manpower in such a manner as to be an advantage to the employer and the employee. Our activities along certain lines here mentioned are conducted with the operation of our daily routine of work and if we may judge the measure by the experience of our efforts and favorable current reports, our success has been manifold.

Officers	Associated General Contractors of America	*Directors*
W. J. Wilkinson, *President*	Northern California Chapter	Geo. C. Bassett
	successor to	W. A. Bechtel
Jas. D. Fraser, *Vice-President*	Contractors Association of Northern California	J. S. Caldwell
	625 Market Street	J. L. Fairbanks
Earle G. Lloyd, *Secretary-Manager*	Telephone Douglas 2416	Jas. D. Fraser
	San Francisco	J. P. Holland
	Skill - Integrity - Responsibility	W. J. Wilkinson

October 29th, 1926.

Mr. Glen B. Ashcroft, *President*,
Society of Engineers,
San Francisco, California.

Dear Sir: With today's copy of the *Western Construction News* we received a copy of the report and recommendations of the special committee of your Society on the question of the highway financing measures, Ballot Amendments Nos. 4 and 8.

The report is concise, clear and definite, and coming as it does from a group of representatives of a profession that is probably in better position to clearly analyze the situation than any other trade or profession, we feel that the report can be accepted as authoritative and will carry great weight with the people in whose hands it falls.

We congratulate your Society and the members thereof who submitted this report, and with best wishes for the unlimited success of your organization, we are

Very truly yours,

E. G. Lloyd.
Manager.

American Association of Engineers

NATIONAL HEADQUARTERS
63 East Adams Street
CHICAGO, ILLINOIS

C. J. ULLRICH, *President*

Office of the President
422 NESS BUILDING
Salt Lake City, Utah

Sept. 28, 1926

To the Officers and Members of the Society of Engineers,
952 Pacific Bldg.,
San Francisco, Calif.

Gentlemen:

In behalf of the American Association of Engineers, I am glad of the opportunity to extend the Association's greetings to the Society of Engineers, and to wish it well throughout the coming year.

Engaged in a common cause, that of advancing the welfare of the Profession, the Association is naturally solicitous of your success. There is a greater need for welfare work today within the Profession than at any time in the past. If Engineers ever expect to receive proper public recognition, to advance the ideals and standards of their Profession and to improve their individual status they must be prepared to render service to the public, to their Profession and to themselves. Such service to be effected must be rendered in a co-operative and co-ordinated way through organizations like the American Association of Engineers and your Society.

The Engineer is no exception to the slogan that "Every man is a debtor to his Profession" and it behooves him to discharge his indebtedness to his Professional heritage, not only by joining a Professional organization, but also by taking an active interest in the efforts of that organization.

The American Association of Engineers, as the parent welfare organization of the Engineering Profession, stands ready and willing to extend a helping hand to its sister organization and to co-operate with it in any and all things that are for the betterment of the Engineering Profession.

We hope that when the present Officers of your Society render an account of their stewardship a year hence they can point with pride to their accomplishments and to the loyal support of the membership.

Sincerely,

C. J. Ullrich.
President, A. A. E.

For Effective Service and Successful Achievement, Men Must Pull Together

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The Builders' Work of Other Days—Portion of the Water Supply System of Ancient Rome.

On Engineering Public Address

By Arnold Perstein
Professor of Public Speaking, University of California

In 1921 there appeared a book entitled *Models of Speech Composition.* It aimed "to make available within the covers of a single volume, complete copies of a number of good examples of each of the principal kinds of public speeches common to American life today." That the book is used widely is of little interest to Engineers. What ought to be of significance to them is the fact that the compilation presents speeches by professional men of all types, business men of national standing, educators, and publicists; but one looks in vain for a speech by an engineer.

And, what is still more significant, the textbook of which I write is no exception to the general rule in books of this kind. One is reluctantly forced to the conclusion either that engineers speak infrequently in public, or that, because of long disuse of this means of self-expression, their public utterances lack in the qualities which would make them useful as models. It matters little what explanation holds; the fact remains that the too general absence of speeches by engineers is a matter to be deplored.

More particularly, the teacher of public speaking wonders frequently why the engineer, or anyone for that matter, who presents acceptable qualifications for oral public communication, is in reality the first to express his inability to meet the test. I do not want to make of this paper a classroom dissertation, but I fancy my position may be made a deal clearer by a brief discussion of a few primary matters involved in good public address.

Content, substance of the speech, and form, the manner of speech, are the basic considerations; but of first importance is content. In other words, one who is merely a combination phonograph and windmill cannot hope to get far in the matter of making any lasting contribution to anything through the medium of the spoken word. Form, to be sure, is important although it should be understood that it achieves its importance largely as an adjunct to content. If, then, form is to be relegated to a secondary position, the person who aspires to leadership in public speaking must know that good content, clear thinking, individuality, and originality are of primary concern.

It is the attempt to discipline the minds of the students that has prompted so many Universities throughout the country to make the beginning course in Public Speaking one in analysis rather than one in practice work on the platform. The assumption is, of course, that the student should be taught to think—at best not an easy task—before he is permitted to speak. The results of this new procedure are as one might expect, for invariably the thinkers emerge at the head of the class when the students are finally permitted to mount the platform.

Certainly engineers, in common with other scientifically-minded men, are secure on the score of content; they have "something to say." I think the diffidence, timidity, and self-consciousness attributed to engineers as speakers do have a basis in fact; and this triumvirate, which keeps the great mass of them from the public platform, takes root from a misunderstanding concerning the relative importance of content and form. If it could be realized that content is of paramount significance; that, in the last analysis, the same elements which contribute to good conversation contribute to good public speaking; that, in short, public speaking is expanded conversation, the comment, "I am an engineer and you must not expect me to speak in public" would soon fall into commendable disuse. It is a comment not warranted by the facts.

Once the engineer perceives the true nature of public speaking his progress is quickened markedly, for his perception is keener than that of the average student. The San Francisco Society of Engineers showed this to be true during the spring of 1926 in a class which I had the pleasure to conduct. It was truly interesting and enlightening to watch engineers, young and old alike, speedily grasp and act on the concept of public speaking as expanded conversation.

The drawback of most students of public speaking , a lack of good content, something to talk about, does not hamper the engineer. In the main, his training, his scientific interests, his logical mind, his aptitude for visioning what Galsworthy calls our modern "Castles in Spain"—these and other noteworthy traits make the things he says of some moment. What a relief in this day of so much wasted vocal effort to hear in public one who knows whereof he speaks; and one who, incidentally,

talks of things that usually add to the sum total of cultural values.

When the engineer comes out of his shell, as Herbert Hoover has put it, and completely fathoms public speaking as a useful art and never as a merely ornamental art, as expanded conversation and not as a difficult and dangerous performance of shouting flowery phrases in a black crepe voice, punctuated by certain prescribed sawings of the air with the right hand and clenchings of the fist with the left, I shall then discount Carlyle's statement to the effect that "England and America are going to nothing but wind and words."

Value of Traffic Statistics

An Excerpt from Records of the Public Affairs Committee

The question of statistics is important. No problem dealing in motor vehicular traffic and safety can be solved on the principles of proximately, remotely and generally, and using no method of estimation, no guiding principle enables us to say whether a proposed course or method of prevention or solution is even relatively right. It is not a mere assumption for us to assert that the greater problems of city-planning deal directly with the transportation of passengers and freight, and if we provide traffic needs for the future it is natural that we must plan our system to a relative degree by facts and figures.

Accident Statistics

The scope of activity offered and methods to be employed for promoting safety can only be determined by a comprehensive study of accidents according to their types and causes, made possible by the collection of data through an organized and systematic effort. It is the subject of nation-wide concern, especially in regard to uniform reporting, assembling, ratio, proportion, and the publication of traffic accidents. Few states have made arrangements in such a way that centralized statistics are available and the extent of data required to be reported varies greatly. In the consideration of the question of uniformity it is appropriate that our State should take necessary steps to produce records agreeing as near as possible to some form of standardization.

(1) The collection, analysis and publication of accident reports should be invested in the care of some state agency or centralized body, preferably one identified directly with traffic and highway safety and one holding authority to issue or revoke drivers' licenses, to receive accident reports, and to investigate accidents, whether accruing within or without the corporate limits of municipalities.

(2) Extent of detailed information, standard definition of terms, tabulating schedules and all compositions which enter into the accident, fatality, personal injury and property damage analysis should be made on the basis of an agreed standardized form.

(3) In order to make a systematic effort to secure from their sources, accurate and complete data regarding accidents, their types and causes, it should be obligatory by law for those concerned to report all traffic accidents, and an adequate penalty for failure to report should be provided.

(4) That cities, by action of their Board of Supervisors, rather than await State legislative authority, made the provisions necessary for the local agency to establish itself and function along lines herewith proposed.

Traffic Statistics

No type of traffic has been so completely revolutionized within the past decade as the automobile. Six years ago, when the total registration of motor vehicles throughout the United States was 9,232,999 it was generally conceded that the point of saturation would soon be reached. For the year 1924 the registration reached the amazing aggregate of 17,591,981. The largest numerical gain for the year was, in California, equivalent to 27.2 per cent. Her total, 1,319,394 showing one passenger car or truck for every three persons. This ratio has yet to reach its ultimate figure, but now it cannot be far from the limits of proximation. Nevertheless the trend of registration will follow the population fairly uniformly, and we will ever be confronted with the problem of growth.

So rapid has been the development of motor traffic that we have been unable to keep pace with its growth through the furnishing of proper street and highway accommodations. Traffic under the strain of congestion has

handicapped our facilities and just as the condition exists today, we must keep in view the anticipation of a much greater volume of density.

To devise some practical method of determining the number of vehicles in actual use at a given time on the city streets should be a comparatively easy task. This information has long since been sought by traffic experts and vehicular traffic statisticians for the vital assistance it can render in the solution of certain problems, particularly the forecasting of perennial traffic. By aid of several airplanes acting simultaneously the entire city could be photographed. Photographs to be taken at the peak hour of traffic and at an elevation permitting legible figures of the cars to appear on the projected map. Comparing the number of cars appearing on the map to the entire city registration would furnish the proportion; deducting the number of idle cars at the curbs would give a final result of cars in actual transit. From distinct photographs secured at a low elevation truck traffic could be distinguished from passenger traffic.

If air surveys are made at a number of intervals it is safe to assume we could secure an averaged ratio for our practical purposes and which would be in the approximation of exactness. These maps would not only be useful in showing density, but also definitely locating the traffic and flow graphically indicated and recorded for each and every street. However this method cannot register clearances and velocity, kinetic volume and the flow of the maximum traffic per unit of time can only be determined through the medium of an actual traffic count, taken during the peak hour. Here the question naturally arises as to the extent or number of places at which these counts should be taken. The value which can be derived from traffic statistics of this nature is incalculable to those seeking a solution of traffic problems, bearing this in mind the greater portion of a city should be so effected. This value may be better illustrated by reviewing an expression by the city of Chicago, which recently appropriated the sum of $40,000 for this particular cause.

Why the necessity and what logical advantages can these statistics offer? The city planner of today can no longer base his design merely upon the theory of aspiration, the result of artistic inspiration, nor does the engineer fix his purpose by assumption. Solution of the traffic problem can only be found with the aid of hard and fast rules forming a decision partly secured through the medium of mathematical deductions. There are at least 10 cities in the country today, each spending from $50,000,000 to $200,000,000 on water supply, preparing their systems to take care of needs for the next 50 years. The engineers so engaged are guided mainly in the execution of their plans by proved mathematical findings. Likewise the characteristics of the salient features of traffic must be determined and analyzed before we can logically prepare our city and regional plan for the present and future.

Co-operation

The spirit of fraternalism is becoming more pronounced with each succeeding year among the engineering profession. A keener interest is manifested by all engineers not only in that particular phase of individual duty, but as concerns the fellow engineer and the profession in general. It is refreshing to know that this unity of effort and service is sowing most productive seed in the fertile soil: namely, the public. Industry, commerce, agriculture and architecture are dependent upon the engineering profession for the initiation of the many and comprehensive projects the world over. Railroads, highways, electric power and energy, steam, bridges, mining, navigation, radio, sanitation, machinery and equipment of all kinds, and the many other contributions to the welfare and convenience of mankind, are factors in the development of human progress in which the engineer has had a very important part.

So whatever phase of engineering you may be engaged in and whatever contribution you, as an engineer, may make toward the uplifting of the profession, will prove invaluable to you and afford an asset that will overbalance all the preparation and experience extending over many years. It is sincere satisfaction to know that one has been responsible to a marked degree in bringing comfort and happiness to mankind.

Howard A. Levering.

Society Activities

LECTURES

Delivered at Society Meetings
Blue Room, Palace Hotel

Jan. 12—Joseph Etiel, "Philosophy of the Open Shop."

March 9—Prof. Emeritus Chas. D. Marx, Member, Board of Consulting Engineers, Port of Oakland; G. B. Hegardt, General Manager, "Proposed Development of the Harbor of Oakland."

April 13—R. S. Prussia, Illuminating Engineer, Westinghouse Co., "Light and Illumination." Accompanied by demonstrations with light affecting apparatus.

May 11—Dr. D. W. Hanna, California Academy of Natural Sciences, "Animal Life of the Guadalupe Islands." Illustrated by moving pictures.

Sept. 14—E. L. Mathy, Industrial Engineer, Air Reduction Sales Co., Oxygen, "The World Wonder Workers." Illustrated by moving pictures, and demonstrations with liquid air.

Oct. 12—G. Harold Porter, Manager Pacific Division, Radio Corp. of America, "Marvels of the Radio." Illustrated by moving pictures.

Nov. 9—W. J. Bevan, Asst. Cashier, Wells Fargo Bank & Union Trust Co., "What the Engineer Can Do for the Bank and What the Bank Can Do for the Engineer."

EDUCATIONAL VISITS

to Industrial Plants

April 3—Illinois Pacific Glass Co., Fifteenth and Folsom Sts.; courtesy of P. D. Burtt, General Plant Superintendent.

April 3—Enterprise Ice Company; courtesy of G. W. Geisler.

May 1—Pacific Telephone & Telegraph Co., General Office Building, 140 New Montgomery St., and Bush Street Exchange; direction of L. Pullen and Geo. W. Van Buren, Commercial Representatives.

May 22—San Francisco *Chronicle*. Viewing the complete workings of a newspaper plant.

May 29—Chabot Observatory, Oakland. Inspecting great telescope, accompanied by explanations and lecture.

June 5—Merchants Ice & Cold Storage Co., 1330 Sansome St.

Sept. 18—Hunters Point Drydock. Viewing pre-cast segments of the Alameda Estuary Subway; courtesy of Lochiel M. King, Const. Engr., Alameda Co.

Oct. 9—National Ice Cream Co., 336 Guerrero St.; courtesy of G. R. Smith, Production Manager.

ANNUAL DINNER

PIG'N WHISTLE
June 8th, 1926

Arranged by the Public Speaking Class

Music
Severe, Oller

Special Committee Report—Engineering interspersed with personified hokum
Ashcroft, Brier, Green, Waite

The Engineer of Today
Van Acker

The Engineer of Yesterday
Geisler

The Engineer of Tomorrow
Von Seggern

Speaking of Speaking Engineers
Capron

The Engineer Here and Hereafter
Christiansen

The Engineer as a Talking Machine
Walker

Random Thoughts of a Tired Engineer
Zimmerman

Engineering Aspects of a Modern Flapper
Graff

A Debt the Public Owes to the Engineer
Tonney

Is the World Going to the Dogs?
Landers

ANNUAL ENTERTAINMENT

Aahmes Temple, Oakland, April 16th

A presentation of vaudeville specialties in speed, color and song. Various numbers ranging from a toe ballet to a lecture on Astronomy. Stella and May realizing that the basic element of talent must be presented in a new way to attain novelty and beauty, their sister act displayed fine vocal prowess. The musical selections by Tony Carus revealed talent well appreciated. Entertainment by direction of Louis F. Leurey.

CLASS IN PUBLIC SPEAKING

PROF. ARNOLD PERSTEIN, *Instructor*

Glen B. Ashcroft	W. W. Brier	Robert G. Green	John Oller
J. J. Van Acker	A. J. Capron	H. Graff	Otto Von Seggern
Geo. E. Ahnger	Paul Christiansen	H. A. Jackobson	A. C. Stransky
R. E. Beiter	F. Freitag	Walter Landers	Geo. T. Waite
	J. M. Church Walker	A. E. Zimmerman	

ORCHESTRA

JOHN OLLER, *Director*

S. R. Fox   Tracy R. Plant   Ralph Luckenbach   Louis J. Severe   A. C. Stransky

DEDICATION DAY

OCTOBER 24TH, 1926

The Society of Engineers by invitation of the Mt. Diablo State Park Commission was accorded the distinction of dedicating the sister peak of Mount Diablo, bestowing upon it the name of Ransom's Point, in formal acknowledgment of the work and services of Col. Leandro Ransom, Pioneer Engineer, as a sign of respect and honor to his name, sixty members of the Society being present.

President Ashcroft in his address, selected and grouped events for their interest or importance in a recount of the history of Col. Ransom, together with the motives that prompted the occasion of this dedication, reminding, that it remains for us, in the fulfillment of our duties as citizens of the rising generation, to repay in a degree at least this measure of concrete recognition to chronicle and commemorate the noteworthy accomplishments of such a noble character.

Hon. L. F. Byington, Member of the Mt. Diablo State Park Commission, outlined the purposes and aims of the Commission and stated its intent to make possible the extension of the Park along new and advanced lines, that the people of California may be justly proud, for here Nature has deftly set the stage with her marvelous scenery, and its access should be publicly established and preserved to posterity.

Mr. A. C. Horton, Cadastral Engineer, Department of the Interior, and in charge of carrying on work originally instituted by Col. Ransom and his fellow engineers, by his contact and knowledge of the official records as delineated by these pioneer engineers, he spoke in the interest of their qualities, representing honesty, energy, perseverance and thoroughness, all of which are identified by the characteristics of their work, the accuracy of which today forms the basis of all operations determining the land areas of Nevada and California.

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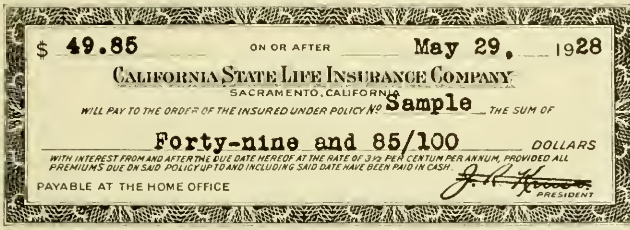

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Concrete Pipe in California

Concrete pipe is a legitimate building material, based on sound economics and good engineering. Engineers can do a great good for the concrete pipe industry and give service to the puhlic by demanding that all pipe installed not only be made according to standard specification but the product be properly tested for the required strength. Every pipe manufacturer should realize that his standing with engineers and with the public depends upon the quality and adaptability of his product.

The first hand-tamped concrete pipe in California was made hy hand-mixing of the materials and moulded in steel forms. The semi-dry materials were tamped into the forms by hand and both jacket and cores immediately removed. This slow and laborious method had many disadvantages. The pipe made under varying conditions, the manufacturers found it difficult to produce a standard or uniform product. It is easier to make a good quality pipe in a large size than it is to make a small hand or air-tamped pipe, as coarse materials and reinforcing are used to advantage. Some manufacturers make large culvert and irrigation pipe successfully hy use of the hand-tamp method, but they use a power mixer on carefully graded materials.

The use of concrete pipe for irrigation called for the manufacture of metal appliances in the form of gates, valves, and tools. This demand developed irrigation specialty companies, they perfecting power machines for pipe manufacture. The power machines now used may he divided into two types—the "packer head" and the "tamping." Both machines produce a well-compacted concrete in the walls, when the materials are properly graded and mixed with the correct amount of moisture and cement. Both types trowel the inside of the pipe smooth and they can build all sizes from 4″ to 24″ in diameter, in 24″ to 36″ lengths, either tongue and groove, or spigot and bell ends. With proper care of the material mix, no difficulty is experienced in manufacturing pipe to meet the standard specifications of the American Society for Testing Materials. Double walls and reinforcing pipe can be made on these machines and some of the machines can be equipped to build pipe up to 36″ diameter. Pipe of the poured type is also made in California for large sewer and water pressure lines. Precast sewer pipe up to 102 inches in internal diameter was built for the Los Angeles outfall sewers.

In 1917 the importance of the industry and the value of concrete pipe for irrigation development attracted the attention of the United States Department of Agriculture. A classification of the materials, methods of manufacture, and a study of the quality of the concrete produced, quickly brought out the necessity for standardizing certain tests, and equipment for making these tests was perfected and is now available for engineers. Great advancement was made in the selection of materials, control of moisture content, and method of curing, which resulted in increased strength and densities of the product.

Hydrostatic pressure places the walls under a tensile strength. This is an unusual duty for concrete when used in non-reinforced pipe as in all other concrete construction. Engineers place concrete under compression only, and introduce a sufficient steel to meet the tensile stresses. High tensile strengths of 300 to 600 pounds per square inch, and imperviousness to the concrete are the two principal qualities sought in pipe making.

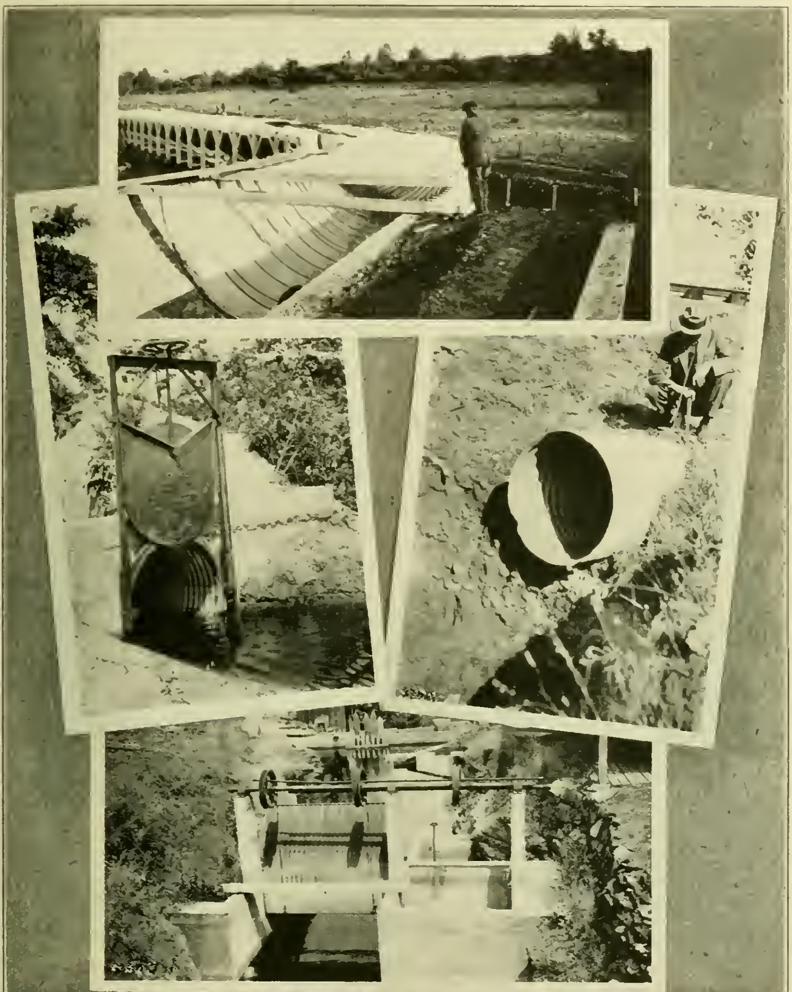
Water tight cement joints eliminate to a large extent the usual infiltration and difficulties experienced from the entering of tree roots through imperfect joints. These connections can be made rigid and tight with comparative ease. The great strength of concrete pipe for sewer purposes has caused its use to become permanently estabilshed, especially where high quality pipe is a requirement. The design of outfall sewers that carry domestic and industrial waste presents a most interesting field for careful engineering and construction.

The combination of steel and concrete has revolutionized the construction of great buildings, and the same combinations will ultimately expand the uses of reinforced concrete pipe into unlimited fields. Engineers who may work out adaptable designs, method of manufacture, applications of pipe to high pressure duty, cost, carrying capacities, and durahility, can give concrete pipe many unequaled economic and engineering advantages and our improved methods of manufacture, together with the recent successful control of water surge and water hammer, and the contraction and expansion in high pressure lines, make certain an early advance into these fields.

At present there are more than 15,000 miles of concrete pipe in use in California, and it is safe to say the State leads the other states in the amount of pipe installed, the number of pipe manufacturers, and the immediate potential field for its use.

Milo B. Williams, C. E.

Greetings From Old Friends



Those who help us with our work we rightly class as friends. Among these every California engineer includes the Armco Lennon Type Flumes, Armco Corrugated Culverts, Calco Slide Headgates and Radial Gates whose portraits are given above. They are Time-Tried and Service Proven.

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—Ruskin—*Seven Lamps of Architecture.*